PORTLAND MUNICIPAL TERMINAL NO. 4 GRAIN ELEVATOR
11040 North Lombard Street
Portland
Multnomah County
Oregon

HAER OR-163
HAER OR-163

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street, Suite 700
Oakland, CA 94607

HISTORIC AMERICAN ENGINEERING RECORD

PORTLAND MUNICIPAL TERMINAL NO. 4 GRAIN ELEVATOR

HAER No. OR-163

Location: Port of Portland Terminal No. 4
11040 N. Lombard Street, Portland, Multnomah County, Oregon 97203

Universal Transverse Mercator Coordinates: 10.5050067.517652
T1N R1W, Section 2, Willamette Meridian, Near River Mile 4.5

Present owner: Port of Portland

Present use: Vacant

Significance: The Portland Municipal Terminal No. 4 Grain Elevator is historically significant for its association with the beginning of publicly owned and financed port facilities, and architecturally for introducing modern fire-proof concrete elevator construction and innovative grain handling technologies to the city.

The Municipal Terminal No. 4 Grain Elevator was completed in 1920 under the supervision of the city's Commission of Public Docks (CPD). The first large-scale development undertaken by the newly appointed CPD, the terminal was designed for efficiency, and upon completion, was one of the largest shipping facilities on the West Coast. The terminal included docks, piers, slips, warehouses, rail service, and a one million bushel grain elevator. The new grain elevator marks a shift towards public ownership of Portland's waterfront; prior grain elevators, warehouses, and docks were primarily owned by private businesses.

In an effort to compete and capture more of the regional wheat export business, the CPD hired the Chicago firm of Witherspoon-Englas & Co. to design the new state-of-the-art concrete grain elevator with the most modern equipment. Constructed in three distinct sections, the elevator had a track shed, operating house, and storage bins. The operating house had reinforced board form concrete walls, and the bins were built using an innovative slip-form construction method. The facility handled both sack and bulk wheat, a necessity in the competitive grain market. The grain elevator was the central feature of the new shipping terminal.

As technology and methods of handling wheat changed, the CPD and leasee updated and added to the grain elevator. For many years, the Port's grain elevator handled more wheat than any other terminal facility in the PNW. The municipal grain elevator symbolized the importance of Terminal No. 4 in the development of the Pacific Northwest (PNW) wheat industry and of the Portland harbor.

PART I. HISTORICAL INFORMATION

A. Physical History

1. **Date of erection:** 1920

2. **Additions:** 1930 (Storage Annex Addition); 1954 (Steel Storage Tanks Addition)

3. **Engineer:** 1918 Design, Chicago, Witherspoon-Englar & Company, Chicago, Ill.
   1930 Storage Annex Addition, City of Portland Engineer, A.D. Merrill
   1954 Steel Tanks, Portland City Engineer & Tudor Engineering Co., San Francisco, CA

4. **Original owners:** City of Portland, Commission of Public Docks

5. **Contractor:** 1918-1919 Construction, Grant Smith & Company, Portland, OR
   1919-1920 Completion of contract by the City of Portland
   1930 Storage Annex Addition, Albertson & Cornell Bros., Tacoma, WA
   1954 Steel Storage Tanks, American Pipe and Construction Company

6. **Original plan and construction:** Completed in May of 1920, the Portland Municipal Terminal No. 4 Grain Elevator was built as three distinct interconnected concrete buildings: track shed, operating house, and storage annex. Subsequent additions included two large storage annexes built in 1930 and 1954. The 1930 storage annex was comprised of concrete bins and the 1954 addition included eight metal grain storage tanks (demolished 2008).

   The track shed, about 28' high, has three bays for receiving and loading grain into railroad cars and a connected car tipper on the south facade. The 182'-0" high operating house is located between the track shed and the two storage annexes. Penthouses were added to the operating house over time. The 1920 storage annex, about 97' high, is located on the north side of the operating house, and has 63 main cylindrical storage bins. The 1930 storage annex, which is north of the original annex, is slightly larger, with 72 main cylindrical bins. Enclosed conveyor galleries connect the storage annexes and the operating house. Various shipping galleries (currently being removed) extend south and west from the operating house. A corrugated metal building, used for an office, was added on the east side of the operating house in the 1970s.

7. **Major alterations:** The original grain elevator and storage silos are virtually intact with the exception of office and equipment room additions, and modernizing interior equipment. The newer equipment includes wheat washers, air filtering equipment, dust collection systems, a shop, roof top penthouses, car tipper shed, and shipping and receiving conveyors and galleries.

B. Historic Context

Development of the Early PNW Wheat Industry

The PNW wheat industry begins with Euro-American settlement of the region in the 1840s and 1850s as missionaries, military personnel, and settlers planted wheat for subsistence and local trade. Euro-Americans quickly realized that the PNW's climate and fine loam soils were ideal for growing wheat; settlers began producing the grain for heightened demands created by the 1860s gold rush.

Gold strikes in Idaho, eastern Oregon, western Montana, and central British Columbia accelerated agricultural development in the PNW as miners traveled through Oregon and Washington buying local commodities. This new demand provided the impetus for wheat farmers to increase production. As the mines waned by the late 1860s, demand for locally grown wheat decreased. PNW farmers had to find new markets for their wheat and looked to the rapidly growing city of Portland, Oregon.

In the late 1870s, ships began transporting PNW grain from docks in Portland to markets in California, the East Coast, and England. While exports expanded, high transportation costs from farm to market cut profit margins; shipping to ports was cumbersome. Farmers from the "Inland Empire" of northeastern Oregon, eastern Washington, and northwest Idaho, transported wheat by wagon to steamboat landings on the Snake and Columbia rivers, a time-consuming and costly process.[1] Grain shipped down the Columbia River to Portland had to be unloaded, ported around Celilo Falls and Cascade Rapids (Cascade Locks), and reloaded in order to reach Portland docks.

As more people moved into the interior grasslands of the "Inland Empire," new markets developed. Wheat farms began replacing lands originally used for grazing stock and entrepreneurs erected flourmills as wheat production increased. By the end of the 1870s, wheat exports outranked all other commodities shipped from the PNW. In 1879, over 9,400,000 bushels of wheat were produced in Oregon and Washington.[2] Despite the success of the industry, farmers were paying high freight prices, and looking for ways to lower transport costs; the completion of the railroads through the PNW gave farmers the expectation of decreased shipping costs.

The Railroad Era

In the early 1880s, the Northern Pacific and Union Pacific railroads built separate railways to the PNW. Branch lines quickly spread across Oregon and Washington's farmlands. The promise of lower freight costs was not realized until the 1887 Interstate Commerce Act was passed. The Act forced railroads to lower freight costs, giving farmers a competitive way to ship their grain. As inland transport costs stabilized, PNW wheat production increased.

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[1] In the late 1800s, the rich agricultural areas of Columbia Basin of WA, OR and ID were coined the "Inland Empire."

[2] U.S. Department of Interior, Census Office, *Report on the Production of Agriculture as Returned at the Tenth Census*, Washington, D.C., June 1, 1880.

In the last two decades of the nineteenth century, the railroad network expanded further into the "Inland Empire," making markets more accessible. The railroad companies also touted the virtues of the PNW as one of the best agricultural regions in the world, and sold thousands of acres of railroad-owned lands at reasonable rates to would-be farmers.

As the rail transport improved growers' ability to sell wheat, other factors increased productivity and lowered costs, including the use of new fertilizers and farm equipment, herbicides and pesticides, crop rotation, and hardier plant types. The change from animal power to tractor also improved productivity. PNW river and coastal towns vied for the position of being the area's major port. Portland was no exception.

The Port of Portland Commission and the Commission of Public Docks

In 1891, the Oregon Legislature established the Port of Portland Commission (PPC) whose main objective was to develop Portland into a major West Coast port. The PPC emphasis was on deepening and maintaining a shipping channel from Portland to the Pacific that would increase marine traffic to capture the business of the regional wheat industry and other local commodities. The PPC's other main objective was to issue bonds to help maintain the shipping channels, a never-ending task. Portland seemed to be on its way to capture Oregon and Washington wheat markets that produced 35,000,000 bushels of wheat in 1900.[3]

By 1905, the PNW, Kansas, and the Dakotas were the three major grain-growing regions in the United States. Grain production had been fully integrated into the national economy. Ports continued to develop and expand their roles in exports and imports. In 1903, the PPC expanded its role and built the first public dry dock in Portland to repair damaged ships. Five years later, the PPC started a towage and piloting service between the Pacific Ocean and Portland.

At this time, there were several private grain docks on the west and east sides of the Willamette River. The large wheat and flour businesses owned a majority of these structures, including the Portland Grain Company; Balfour, Guthrie, & Company; Kerr, Gifford, & Company; and Pacific Coast Elevator Company, who built a wooden bulk grain elevator at its dock. These facilities coupled with other private docks and buildings made an active and congested waterfront.

As new port facilities were planned and developed, divergent interests began to surface. Many of the community leaders and PPC were aligned with the railroad companies, which handled a majority of the wheat being shipped from the PNW. Once welcomed and thought of as a panacea for transporting and distributing local commodities, the railroads began to monopolize markets and waterfront commerce, limiting development by other public and private interests. In the midst of the social and political reforms of the early twentieth

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[3] U.S. Department of Interior, Census Office, *Abstract of the Twelfth Census of the United States*, 1900. Washington, D.C.: GPO, 1902.

century, journalists and citizens began calling attention to corruption in city governments and the questionable business practices employed by large companies such as the railroads. The PPC was not immune to this type of criticism.

Conflicts arose when some members of the PPC wanted to keep the status quo by allowing the railroad to monopolize the shipping market. Other PPC members wanted to develop public shipping facilities, diverging from the traditional role of the PPC. Due to public outcry and the conflict of interest of some PPC commissioners, the voters approved a new commission in 1910: the Commission of Public Docks (CPD). The new commission's goal was to construct and maintain municipally owned docks, and shift portions of Portland's waterfront into the public sector.

The CPD promptly hired a team of consultants to create a harbor development plan. The CPD stated that,

> *A port is a clearing house for commodities. . . . The activities of a clearing house makes necessary the three following points: easy ingress, quick transfer and easy outgo, together with a large capacity and corresponding heavy use, so as to make the clearing house process an economical one. Thus seaports must be so located as to be easy of access by water, rail, and highway.*[4]

Portland's port was in an advantageous location, protected from the open sea, and near a large population base and access to vast natural resources. The new commission also had the authority to tax citizens, issue bonds, and acquire land by eminent domain.

The same year the CPD was established, Portland exported 3,683,077 bushels of wheat on the domestic market, becoming the number one wheat exporter in the United States.[5] Over 5,100,000 bushels of PNW wheat were exported to foreign markets the same year. By 1912, Portland's domestic wheat exports had increased to 4,822,382 bushels, and foreign market exports to 7,430,194 bushels. Wheat was shipped to South America, Asia, Europe and the Philippines. The Globe Grain & Milling Co. built the first concrete, fireproof grain elevator on Portland's waterfront.

In response to the increase in exports, the CPD constructed two shipping terminals, a public dock, motorboat landing, recreational pier, coal pier, and fireboat dock. By 1914, many of the waterfront improvements had been completed, which coincided with the opening of the Panama Canal (reducing shipping cost and time) and the beginning of World War I. As exports increased, so did pressure to reduce shipping and storage costs. Industry stakeholders debated cost and handling advantages of sack versus bulk storage and shipping; this debate continued for the next 20 years.

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[4] *Annual Report of the Commission of Public Docks of Portland, OR* (November 1912) 30.
[5] Ibid., pp. 35, 118.

Sack Versus Bulk

Prior to rail transport, grain was shipped in jute/burlap sacks to domestic and foreign markets. After the railroads reached the PNW, the rail companies lobbied growers to ship wheat in bulk. Bulk elevators were built in rural areas near the railroad track so bulk grain could be transported to Portland shipping terminals. However, this movement was short lived as shipments of wheat were relatively small prior to 1900, and farmers found it easier to handle grain in sacks. Ship owners also disliked bulk storage; wheat shifting in rough seas was dangerous, especially around Cape Horn. Other concerns of shipping companies were threat of fire and spoilage due to overheating while sailing through the tropics. Insurance companies began effectively limiting shipments of grain in bulk by raising rates and sometimes prohibiting bulk shipping altogether. Sack proponents also argued that smut, a wheat fungus, could be contained better if wheat was stored in sacks as opposed to bulk. One exporter at a grain convention stated, "Gentlemen, you cannot get rid of the sacks until you get rid of the smut."[6]

As productivity and competition increased after 1900, another movement towards bulk storage began again. This met with strong resistance from the coalition of grain growers who preferred shipping in sacks, and the sack and twine manufacturers who were threatened by the elimination of their product. Also, bulk storage and shipment from the major ports in Seattle, Tacoma, and Portland were problematic since most of the ports were only equipped to handle sacked grain. The debate continued. The growers were split in two camps; the "elevator men" and "sack men." [7]

The sack camp argued that bulk storage facilities had been tried before but were later abandoned, and deemed unprofitable and expensive to build. Sack promoters further stated that sack grain warehouses and handling equipment were already in place, and new facilities would be too costly to build, insurance costs would increase, and sorting grain would be more difficult. A system of warehouses was built along railroad lines for storing sacked wheat before shipping. Often large companies (particularly the flour companies) owned these warehouses, and would buy the wheat from farmers, store the grain, and ship the wheat to markets. These companies often drove market prices.

Elevator men argued that the new Panama Canal reduced risks and shipping time to foreign markets, saving time and money. In 1916, an independent committee from Spokane, WA studied the cost of handling bulk versus sack grain.[8] The committee determined that there was a savings of 2.25 cents per bushel if the grain was handled in bulk. Other arguments included the fact that the grain needed double handling; sacked once by the farmer, and re-sacked at terminal facilities if the wheat was shipped overseas.

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[6] D.W. Meinig, *The Great Columbia Plain, A Historical Geography, 1805-1910* (Seattle: University of Washington Press, 1968) 398.

[7] H.T. Lewis, "The Elevator Movement in the Pacific Northwest," *Journal of Political Economy* (1916) 796. Jute, needed during World War I, was on the embargo list.

[8] Ibid., 799.

World War I pushed the development of bulk grain facilities in the PNW. Wheat prices were at an all time high, and so were the sacks used to store and transport the grain. The jute and burlap, used in making sacks, were needed in the war effort. Because of this, the cost of the sacks nearly doubled in the U.S. by 1914. This forced growers and other affiliated companies to consider changing from sack to bulk shipping and storage facilities. Farm storage and country elevators were built, sack warehouses converted to bulk storage, and coastal terminals were enlarged to accommodate the new system. PNW ports in Tacoma and Seattle began adding bulk facilities to their terminals. After visiting the wheat farms of Oregon and Washington, CPD came to the conclusion that if Portland wanted to maintain its place as the number one grain exporter, the city would have to build a bulk grain elevator.

The commissioners began looking for a suitable site for such a facility. The CPD favored locations on the east side of the Willamette River, since the railroads would not have to send cars over the river, which often created congestion on Portland's bridge systems. An eastside location would minimize cost by providing the shortest and most direct routes, particularly from the "Inland Empire." Newly annexed land in St. Johns became the top choice for the new terminal.

The Municipal Terminal No. 4 Grain Elevator

After Portland annexed St. Johns on July 8, 1915, the CPD investigated the feasibility of constructing a large bulk grain facility at St. Johns. The CPD began the research after one of the largest grain exporters lobbied Portland for a municipal bulk grain elevator. The commission prepared preliminary cost estimates and plans for a new facility with a holding capacity of one million bushels. After several meetings with grain exporters and public officials, the CPD decided against issuing a bond for a new elevator. With the United States' active participation in World War I imminent, the CPD felt that the public would not support the proposition.

By the end of 1915, however, the CPD revisited the possibility of constructing a large municipal grain elevator at St. Johns. A number of smaller, rural, bulk grain elevators were constructed to handle the increase demand for bulk storage, and Portland would have to accommodate this growing trend. The CPD instructed G.B. Hegardt, Portland's Chief Engineer, to investigate the possibility of erecting a new terminal.

After careful planning, the CPD decided to float a $3,000,000 public bond measure to fund the terminal construction. On March 25, 1917, an article in the *Oregonian* entitled "Grain Elevator Facility Termed Essential to Port Expansion," touted the benefits of a new efficient facility that would handle grain with the latest technologies and terminal planning. The article states,

> *. . . It will be noticed that the proposed terminal layout is a departure from the usual type of construction so characteristic to this port. In place of the present quay construction, which is a wharf or dock parallel to the river, pier and slip construction have been adopted. It makes possible much better connections with present rail lines and a trackage system along the face of the pier, and there is*

> *positive economy in the amount of river frontage required for the facilities which it is necessary to provide for the ships and shipping to be accommodated.*

The new grain elevator would be state-of-the-art. A fireproof reinforced concrete building, the elevator would handle both bulk and sack grain, enabling the grain to be shipped by either method. The newspapers promoted the idea of a new terminal as a way to help maintain Portland's leadership as a major PNW port.

At the request of the CPD, the Portland City Council proposed an amendment to the City Charter authorizing the issuance and sale of bonds in an amount not exceeding $3,000,000 for land acquisition, construction, equipment, maintenance and operation of grain elevators and all necessary facilities for handling grain and other commerce. The vote was held on June 4, 1917, and passed by a large majority.

On August 1, 1917, the CPD advertised the sale of $1,500,000 Municipal Elevator Bonds bearing interest at 4% per annum and redeemable in three to thirty years. Bids were opened on September 6, 1917, and the Equitable Trust Company of New York, Harris Forbes Company, and the National City Company bids were accepted. Immediate plans for the distribution of the bond money included construction of the grain elevator and piers.

Soon after the bond passed, the CPD continued to evaluate the St. Johns terminal site. Soil conditions were studied, test pilings drilled, and the physical characteristics of the sites studied with reference to location, channel conditions, bridge and rail connections, road systems, and expansion possibilities. After studying the results, the CPD selected the St. Johns site.

A 153.55-acre parcel of land was purchased for $137,000 along 2,500 linear feet of waterfront on east side of the Willamette River, about 3.5 miles upstream from the confluence of the Willamette and Columbia rivers. Although a suitable site in many aspects, much of the area would have to be filled with material dredged from the Willamette River before construction could begin. The new municipal terminal at St. Johns would include a concrete bulk grain elevator, piers with ship slips, tanks for oil storage, and an open area for future industrial and manufacturing businesses.

The Construction Phase

Previously prepared architectural plans for the new terminal and grain elevator were refined, and the CPD made arrangements with the PPC to help dredge the channel. The PPC donated services for the project by dredging the full width of the river to a minimum depth of 30' at low water level. The CPD hired Witherspoon-Englar & Co. to design the grain elevator, a firm well known for their innovations in fireproof elevators. The design for the St. Johns elevator consisted of a track shed with space for 68 loaded railroad cars, a multi-story operating house with 79 storage bins, and storage annex consisting of 63 cylindrical bins. The elevator would have electric power and telephones throughout. Each separate building was designed to operate independently, a modern innovation in grain elevator technology.

Portland's Chief Engineer G.B. Hegardt was in charge of the construction, and G.W. Boschke was the consulting engineer. After the plans were finalized, the first contract was awarded to Robert Wakefield for driving the pinch pilings for the foundation. On April 9, 1918, the CPD awarded the construction contract to the Portland firm of Grant Smith & Co. for an estimated $798,383. As part of the terms of the contract, the CPD furnished the reinforcing steel and cement to the contractor without charge, along with motors and transformers, rubber belts, and grain cleaning machinery. The commission was able to use some of their ship repair facilities to prepare steel for the project.

Excavation for the foundation started at 4' above the low water level. Thousands of closely spaced, wooden pilings were driven 40' to 50' into the ground. A reinforced 3' thick concrete slab was poured over the top of the pilings. On top of the slab, concrete columns were erected to support the basement floors. Below the high water level, basement walls were sealed with waterproofing embedded in the concrete.

Construction continued through the fall of 1918. The work on the operating house and concrete bins rapidly progressed. The reinforced concrete bins were built using slip-form construction, a modern engineering technique for erecting silos. The forms were constructed on the foundation slab with vertical reinforcing steel rods set in position. Screw jacks, placed at intervals, were used to raise the forms. Workers operated the jacks at a calculated rate so the concrete would set before the forms were raised and the next section poured.

In January 1919, work on the elevator came to a standstill when it was discovered that the northeast corner of the storage annex had settled as much as two feet as a result of sand used as fill. At this time, the concrete storage annex was about two-thirds complete and the operating house was at a height of about 15' above the foundation.

The CPD organized a board of five engineers to resolve the settlement problem. The report determined that not enough preliminary borings or test pilings were completed prior to construction and that some of the original conclusions about the tests were faulty. The board also asserted that the original location for the elevator was planned about 300' west of the final site location; the elevator designer from Witherspoon-Englar relocated the building when visiting the site in 1918 without ordering new borings to test the soil. The consulting engineers for the project published a report, which discussed the possible reasons for the settling. An April 30, 1919, *Oregonian* article states,

> *Summarizing the conclusions as to the cause of the trouble, we would state that it is our opinion that too great a load per square foot was placed upon the foundation because of the character of the material at which the load was applied and the piles being driven so close together that they simply acted as a means to transfer the surface load to a point at elevation minus 41' where the bearing value of the soil is at least no greater than that at the surface.*

The board of engineers agreed on a plan of action to stop the subsidence. First, pinch pilings would be placed all around the storage annex, operating house, and track shed. These new pilings enclosed the foundation pilings on the northeast and the entire east facade, which helped stabilize the structure. Second, by sluicing and pumping, the fill around the footing system was removed, and the voids were filled with concrete. These efforts stopped the subsidence. Despite the problems with the elevator, the new St. Johns Terminal opening ceremony was held in April 1919. Construction on the elevator resumed in the summer of 1919 and continued throughout the year.

The Completion

The grain elevator was finished in May 1920 after delays in receiving and installing the necessary equipment. The modern equipment included receiving and shipping legs, separators, washers, smutters, conveyor belts, hopper scales, elevators, ship delivery spouts, and sweeper and dust collecting systems.[9]

The new facility was touted as being a modern facility with a capacity of storing over a million bushels of wheat in the operating house bins and storage annex. The elevator was the first grain facility built by the CPD and the largest in Portland; the other grain elevators were in private ownership. The facility was designed to clean, sort and store various grades of wheat. The wheat was inspected according to the guidelines of the 1916 U.S. Grain Standards Act. A government inspection office was even opened at the terminal so wheat could be inspected anytime, day or night.

The grain elevator facilitated the quick and efficient shipping of both bulk and sack wheat. Several railroad tracks led to the track shed that held 70 loaded cars and 90 empty cars at one time.[10] Car pullers were installed to help maneuver the rail cars over the track shed dump hoppers. The shed was equipped with power shovels for unloading bulk grain at a capacity of 120,000 bushels of wheat every eight hours. Sacked grain was unloaded onto a concrete platform between the two unloading tracks. The sacks were piled, cut, and unloaded through grates in the platform to concrete dump hoppers below. The hoppers funneled the wheat onto one of three conveyor belts in the basement.

The trough-shaped conveyors were made of rubber and cotton warp belts. The conveyors transported the grain to a boot that collected the grain in the operating house basement. The grain was scooped up from the boot by a main receiving leg and transported in buckets to the top of the operating house. The receiving leg discharged the grain to garner hoppers and then to scale hoppers for weighing before distribution to storage bins.[11] Nine scale hoppers each weighed a maximum of 2,000 bushels at a time, and one smaller hopper weighed 1,000

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[9] *Annual Report of the Commission of Dock Docks of Portland, OR* (November 1925) 11. Two additional smutters were added to the first floor of the operating house in 1923 because of the amount of smut found on the wheat. Smut, a wheat fungus, was removed from the wheat by dumping the wheat into quickly revolving shafts that had beaters that scoured the smut from the grain. The grain elevator smutters ran day and night.

[10] *Annual Report of the Commission of Public Docks of Portland, OR* (November 1921) 13.

[11] The garner hopper collects and holds grain to be weighed in the scale hopper, allowing the elevator and conveyor systems to work continuously.

bushels. Each scale hopper was attached to a Fairbanks-Morse and Co. scale. The elevator had three main receiving and shipping legs, and other specific elevator legs for separators, smutters, washers, and driers. Electric motors operated the various elevator legs.

After the grain was weighed in the hoppers, the wheat was dumped on distributing conveyors that carried the grain from the operating house through a gallery to the storage annex bin floor. Conveyor belts and tripper units would funnel the grain to designated storage bins.[12]

Grain was stored in the operating house or storage annex bins. The operating house had 79 storage bins, varying in size with holding capacities of 300 to 5,150 bushels (50 bins held over 4,000 bushels) for a total capacity of 298,700 bushels. The 63 bins (15' in diameter) and 36 smaller interspace bins between the main bins in the adjacent storage annex held an aggregate of 755,100 bushels. The wheat was stored in the annex until shipping.

The operating house bins had rotating spouts at the bottom that connected to chutes distributing the grain to conveyors or sacks. The storage annex bins had spouts that directed the grain to conveyors in the basement, which transported the grain through gallery tunnels to shipping leg boots in the operating house, then up and out to waiting ships. Most of the grain exported overseas had to be cleaned and re-sacked before shipping.

The new terminal was considered one of the most up-to-date shipping terminals in the nation. A 1920 *Engineering Report* entitled "Municipal Grain and Freight Port Terminal at Portland, Oregon" states,

> *Pacific coast cities have been very much alive in the last few years to the possibilities of ocean trade and have spent and are spending many millions in developing their ports for the more efficient and economical handling of sea-borne freight. Portland, Ore. has been one of the leading communities in this respect, particularly in the extension of municipal construction and control. . . . Portland has long been an important grain-shipping point at times leading in annual grain shipments over any other port in the United States. The city has determinedly striven to maintain its standing as an ocean-shipping point for all classes of freight, although located 110 miles inland, measured along the channels of the Columbia and Willamette Rivers. It has a big natural advantage in the Columbia River, which affords water grades for railway far into the interior as well as to the ocean. For this reason the large wheat-growing section of eastern Oregon and Washington are naturally a tributary to the city.*[13]

By the fall of 1920, the grain elevator was fully operational as known as the Portland Municipal Terminal No. 4 Grain Elevator (Terminal No. 4 Grain Elevator). The terminal included: the concrete grain elevator; Pier Nos. 1 and 2 with transit sheds; Slip No. 1 serving

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[12] A tripper is a movable distributing chute that empties a distributing conveyor into the appropriate storage bins. The belt is lifted above the rollers and passes over a throw-off carriage that discharges the grain into spouts to either side, so that the bins can be filled without any other spout than those provided by the tripper.

[13] W.P. Hardesty. "Municipal Grain and Freight Port Terminal at Portland, Oregon," *Engineering Record* (1920) 179.

Piers 1 and 2; Pier No. 5; Slip No. 3; oil and bulk storage plants; heating plant; fuel oil tanks; track scale; street car service; industrial section; mechanical cargo handling equipment; administrative offices; a lunchroom; welfare building; a cold storage plant; ventilated apple storage warehouse; fumigating plant, and the Terminal Flour Mill, the first private business to locate at Terminal No. 4. The flour mill company leased the land directly west of the elevator and built a concrete mill with a capacity of producing 1,500 barrels of flour a day. Conveyor belts connected the mill with the new grain elevator.[14]

A year after the terminal was completed, Portland exported more wheat than any PNW port. Only Galveston, TX, and New Orleans, LA, ports shipped more wheat than Portland. The new grain elevator was the only municipal facility for handling and shipping wheat in bulk in Portland. The CPD had nine docks that handled grain for private companies, including Albers Bros. Dock; Albina Dock; Columbia Dock No. 1; Globe Milling & Elevator Dock; Irving Dock; Mersey Dock; Montgomery Dock No. 2; Pacific Coast Elevator Co.; Portland Flouring Mills Co.; and a dock for the Spokane, Portland, & Seattle Railroad.[15] These docks provided cleaning facilities and electric conveyors for delivering sacked grain to ships.[16] With the completion of the new terminal, Portland business people, wheat producers, and shippers were looking forward to a prosperous commodities market after World War I; this optimism was short-lived.

The Market Weakens in the 1920s

The first two decades of the twentieth century were prosperous for farmers and grain dealers due to rising commodity prices and the unprecedented demand for U.S. farm products during World War I. Farmers cultivated formerly marginal land and purchased equipment that increased productivity. The world markets changed after World War I; demand for U.S. commodities such as wheat decreased. The hopes of prosperity waned as wheat prices sharply dropped by the mid-1920s.

Many factors accounted for the decline, but foremost was the loss of foreign markets. U.S. farmers could not easily sell overseas because of import tariffs. Additionally, some countries that once depended on U.S. wheat were now growing their own grain. As world market exports decreased, grain prices fell, and producers were left with surplus grain. Additionally, Americans were not buying as much wheat as diets diversified.

In response to this downturn, the Grain Futures Act in 1922 was enacted to reduce sudden or unreasonable fluctuations in grain prices on future exchanges. The Act's supporters believed that such price fluctuations reflected the susceptibility of grain futures to manipulation. Although the Act reassured producers, the economic downturn continued.

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[14] The Terminal Flour Mill, now known as Cereal Food Processors, is still operational at Terminal No. 4.

[15] *The Port of Portland, Development, Progress, & Facilities of the Port.* Portland, OR, 1920.

[16] The CPD installed additional washers (1924 and 1928) and smutters to handle the incoming grain. This was constructed in the space between the operating house and storage annex.

In 1921, shipments of wheat leaving Portland on vessels destined for foreign markets totaled 37,240,987 bushels. By 1923, only 17,732,996 bushels of wheat were exported, a decrease of more than 50 percent.[17] Two years later, another 60% decrease in foreign wheat exports continued the downward spiral. This was balanced somewhat by the increase in domestic wheat exports from 1,051,525 bushels in 1923 to 2,644,901 in 1925.[18]

After World War I, sack material for grain shipping became available again. By 1923, 69% of all the wheat shipped to Terminal No. 4 was sacked. The CPD stated,

> *. . . This is not only an extra expense added to the cost of unloading the wheat, but materially slows up operations during the first couple of months immediately after the harvest, when the annual rush season is on.*[19]

Although the wheat was being transported to the terminal in sacks, 78% of the wheat was exported in bulk.[20] Sacked wheat seemed to be a regional preference that was not shared by other wheat growing areas in the United States.

Despite the economic downturn, Terminal No. 4 remained the most important terminal in Portland's port system. Other agencies opened offices at Terminal No. 4, including the Federal Grain Inspection Division of the Department of Agriculture, the U.S. Public Health Service (Quarantine Station), and an office for the U.S. Customs Service. The Portland Merchant Exchange, agents for the Marine Radio Corp. of America, and a telegraph station also leased office space at the terminal by the late 1920s.

Portland now had enough private and municipal storage facilities and docks to efficiently handle incoming grain. Many of the larger grain dealers had headquarters in Portland, which was also an advantage. In 1925, there were four private grain elevators on the Portland waterfront: Kerr-Gifford Company (250,000 bushel capacity), Strausse & Company (300,000 bushels); and Balfour, Guthrie & Company (270,000 bushels, two elevators).[21] Combined, these elevators had a storage capacity about equal to the Terminal No. 4 Grain Elevator. At this time, no other American port handled the tonnage of wheat exported through Portland.

In 1926, growers from central Oregon formed the nation's first wheat commodities organization, the Eastern Oregon Wheat League (later the Oregon Wheat Growers League). The group exchanged ideas about growing, wheat types, transporting, and marketing, and also worked on mutual problems in the industry. The grain growers, shippers, and distributors were concerned about the future of the market. Growers had planted too much wheat, creating a surplus and driving prices down.

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[17] *Annual Report of the Commission of Public Docks of Portland, OR* (November 1923) 31.
[18] Ibid., 39.
[19] Ibid., 25.
[20] Ibid., 27.
[21] Ibid., (November 1925) 19.

By the end of the 1920s, grain exports started to rise. Portland exported 36,053,336 bushels of wheat to foreign markets, a level the port had not seen since 1920-21. In 1927, to stay competitive with Tacoma and Seattle, who had just finished new grain elevators, the CPD lobbied for an additional one million bushel storage annex for the Terminal No. 4 Grain Elevator. Even after the 1929 stock market crash, the CPD proceeded with the additional storage annex in an effort to protect the local wheat trade and maintain Portland's position as the major grain exporting center on the West Coast.

The Great Depression

The CPD released preliminary plans for the new storage annex in the spring of 1930 and by June, city engineer A.D. Merrill and his staff completed drawings for the storage annex. The storage facility was described in a July 18, 1930 edition of the *St. Johns Review* newspaper,

> *The elevator will be of reinforced concrete construction and will be 114 feet in height. The ground dimensions are 135 feet, 7 ½ inches by 120 feet, 7 ½ inches. There will be 72 circular tanks, each 79 feet deep and having an inside diameter of 14 feet, 7 ½ inches. The tanks are nested, and fifty-six inner spaces between them will also carry grain. The outer and inner walls of the elevator will have a thickness ranging from 7 to 8 ½ inches. It will, of course, be a fire-proof construction.*

The $267,970.68 contract was awarded to the Tacoma firm of Albertson & Cornell Brothers, who hired Baker Construction to work on the pilings for the foundation. Construction started immediately with a crew of 105 men. By July, the foundation was complete and work on the concrete silos began. Newspaper articles praised the CPD on their speedy construction. Three hundred and fifty men were employed on the concrete silos. Chief construction engineer C.L. Fargo describes the continuous pour process for constructing the silos.

> *…..whereby 72 bins will be poured in eight days. This will be done by the use of circular bin forms of the required diameter and each four feet in height. As the concrete is poured these will be raised on reinforced rods, by means of jacks, proceeding at the rate of ten feet a day. We are just finishing the Port elevator at Tacoma… where the bins, each ninety feet high, were poured in five hours less than nine days, by this process.*

The storage annex was completed in the fall of 1930, and the supporting equipment and machinery installed. The three original distributing conveyors were extended from the original bin cupola through a covered gallery to the cupola of the new annex, and the three original shipping conveyors (named Washington, Oregon, and Idaho) were lengthened, extending from the original bin basement through a tunnel to the new annex basement. Dust collection systems and moveable trippers on the bin floor of the new annex were also installed. The elevator now had a capacity of unloading 15,000 bushels of bulk grain per hour and a ship loading capacity of 30,000 bushels per hour.

The additional storage annex was the last big construction project completed at Terminal No. 4 as the Great Depression took hold of the country; only necessary maintenance of existing

structures was approved, and some of these projects were completed with the State Emergency Relief Administration funds (later the Works Progress Administration).

Grain exports plummeted in 1932. Only 4,773,131 bushels of wheat were exported to foreign markets, and the same amount to domestic markets. Despite the exports to Hawaii, China, Japan, Britain, and South America, the decline in trade left a large surplus of wheat.[22] In turn, the surplus caused congestion in a number of markets and tied up railroad cars. It also often caused elevator operators to turn away loads of grain, and railroads to institute embargoes so the system would not be overloaded. The government started programs that benefited farmers and eased the overproduction cycle.

In 1933, Congress enacted the Agricultural Adjustment Act, the New Deal initiative to assist farmers during the Great Depression.[23] The Act was the first comprehensive federal effort to control interstate and foreign commerce in order to avoid surpluses or shortages, abnormally low or high wheat prices, and obstructions to commerce. The Secretary of Agriculture was directed to proclaim a yearly national acreage allotment for the next crop of wheat, which was then apportioned to the states and their counties. This program helped ease the financial crisis of the Great Depression.

Although these laws helped with the surplus wheat, the CPD was contending with labor disputes. West Coast longshoremen pushed for better wages and working conditions while trying to form unions. The labor unrest culminated in 1934 when longshoremen went on strike for over two months, adversely affecting Terminal No. 4 operations. The strike was finally settled when the International Longshore and Warehouse Union (ILWU) was organized.

By the end of the 1930s, wheat production increased as government programs and high crop yields helped bring the industry out of the depression. The industry prepared for an increased demand for PNW wheat as the country anticipated World War II. The CPD responded in 1940 by installing a Fuller vacuum airveyor system on the front of warehouse 4 that would load grain rated at 120 tons (approximately 4,000 bushels) of grain an hour. The existing conveyor belt under the dock was extended to the new airveyor system.

World War II

Portland's economy shifted to the needs of World War II by securing its place as a leading shipbuilding port in the United States. The city was ideal for the industry with its deep harbor, good port facilities, and cheap electric power. Henry Kaiser, an industrialist, was contracted by the British government to build ships for the war. In 1941, the CPD sold Kaiser 80 acres of land at Terminal No. 4, directly north of the grain elevator.[24] This transaction marked the beginning of the war-time use of the terminal.

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[22] *Annual Report of the Commission of Public Docks of Portland, OR* (November 1932) 60.
[23] The law was declared unconstitutional in 1936 and re-enacted in 1938 with adjustments.
[24] Jewel Lansing, *Portland: People, Politics, and Power, 1851-2001* (Corvallis: Oregon State University Press, 2003) 341.

Kaiser manufactured hundreds of Victory and Liberty cargo ships from 1941 to 1945, as thousands of people moved to Portland to work in the shipyards. Employees worked round the clock, seven days a week. The Vanport housing development was built to accommodate the workers, complete with recreation center, child care, theater, schools, and other facilities to meet the needs of the new residents. Over 140,000 workers eventually were employed in the Portland defense industry, and the U.S. Army Transport Service selected Terminal No. 4 as an embarkation port in November 1941.

The U.S. Army officially took over the operation of Terminal No. 4 on January 1, 1942. Under the management of the War Department, the Army renamed the terminal "Portland Sub-Port of Embarkation" (a sub-port of San Francisco and later Seattle) and paid the CPD $16,666.67 a month. The Army took control of the terminal with the exception of the grain elevator, which remained under the management of the CPD until June 1942. After that, the Army managed the elevator, and the CPD shifted maritime shipping activities to other terminals.

Commercial shipping from Terminal No. 4 came to a halt. The U.S. government requisitioned all intercoastal merchant ships, and the War Shipping Administration made all decisions regarding cargo and destinations. Ships carried ammunition, airplanes, aviation fuel, tanks, trucks, medicines, landing craft, locomotives, raw material, food, and military personnel leaving for tours of duty to trans-Pacific destinations.

PNW commodities were in demand to help feed the U.S. population and the troops abroad. The U.S. Government responded to the wartime needs by giving farmers draft deferments and loans to increase production by funding new mechanized equipment, land acquisition, and increased use of fertilizers. Wheat prices sharply increased during World War II as the government bought all the wheat the PNW could produce.

The PNW had bumper crops of wheat in the early 1940s bringing relief to area farmers after the Great Depression. The war also pushed farmers into storing wheat in bulk once again as the material for sacks was at a premium. The Army maintained control over Terminal No. 4 until August 1946, when the facility was released back to the CPD.

Post-War Prosperity

Portland, like the rest of the country, faced a rough transition back to a civilian economy after World War II. Without the massive war mobilization at Terminal No. 4, shipping from the terminal fell below the pre-war levels of 1940. The CPD struggled to catch up with the deferred maintenance at the terminal. A claim was filed against the Army requesting funding for the restoration of the terminal to pre-war conditions. The CPD received over $80,000 in equipment, structures, and supplies, and $50,000 in cash. The Army had also camouflaged all the buildings during the war; repainting was one of CPD's major expenses.

Following the war, the CPD responded to the nationwide downturn by renewing its efforts to attract businesses that would lease the city's industrial lands and port facilities. In the

summer of 1946, the CPD agreed to lease Terminal No. 4 Grain Elevator to Kerr, Gifford & Co. for a yearly fee of $77,000. The company, founded in 1865 in Iowa, was one of the oldest grain companies in the PNW and operated elevators in Portland, San Francisco, Sacramento, Seattle, Victoria, and Vancouver. Although the CPD still controlled the grain shipping piers, the commission effectively changed the city's direct operation of the grain elevator. The new company had a five-year lease on the facility.

The Oregon Wheat Growers League (OWGL) helped the wheat industry in the post-war era by enacting legislation that helped PNW farmers market their wheat and exchange information. In 1946, the OWGL realized the need to market surplus wheat not used for U.S. food, feed, or seed. The dilemma was how to finance this marketing endeavor.

A committee was formed to prepare a report on "Wheat Disposal and Market Development." The adoption of the report in 1947 led to the formation (by Oregon statute) of the Oregon Wheat Commission, the first in the nation. This statute authorized a self-imposed producer tax that was placed on each bushel of wheat at first point of sale. These funds were targeted for marketing, research, and education that supported Oregon's wheat industry. The same year, a record number of bushels were shipped to Japan as part of post-war aid program.

In 1948, the first International Wheat Agreement (IWA) was created. Ratified by four exporting and 38 importing countries, this agreement set the maximum price for wheat. Other IWAs were established, laying the groundwork for later trade negotiations under the General Agreement on Tariffs and Trade. Three years later, the National Association of Wheat Growers was organized, which further unified the wheat industry throughout the United States. These new organizations and international agreements facilitated the expansion into foreign markets, along with federal programs targeted to help producers.

The CPD was well aware of the need to expand export markets. By the late 1940s, productivity increased with the use of new fertilizers and motorized farm equipment. Larger acreages with increased yield were harvested with less labor. As production increased, new bulk grain facilities were built and existing elevators were updated. The CPD reviewed all their facilities and produced a report recommending modernization to stay competitive. This report, referenced in the 1952 *Report to the Commission of Public Docks,* stated that,

> *. . . the future progress of Portland and the State of Oregon is largely dependent on the maintenance of a modern, efficient port. The reason is obvious. Industries cannot develop to their maximum if burdened with heavy road or rail transportation costs on the raw materials they require for production, and on the outward movement of agriculture and industrial commodities.*
>
> *It is the thinking of the Commission that port facilities should be planned and carried out to induce future industrial expansion. In other words, the port should always be capable of handling peak traffic with a maximum of speed and efficiency. Any delays in discharging or loading which result from inadequate facilities of the port add to industrial production costs and reduces the ability of*

industries in the area to compete with industries in other areas which have more efficient shipping facilities.

. . . Continual agricultural and industrial expansion throughout the Inland Empire and the Willamette Valley, for which the Port of Portland is the Gateway to World Ports, will in time exceed the present ability of the port to handle the tonnage. The volume of traffic handled through the port has greatly increased in the past three or four years and there is sound reason to believe that this trend will continue. . . . Ports in the states of Washington and California are spending vast sums to develop new and modern facilities, all of which are being constructed from tax monies and revenue bonds; therefore, your Commission deemed it advisable to have the Commission's charter revised by an amendment which will permit the Commission to issue self-liquidating revenue bonds and to enter into long-term leases.

Increasing Capacity

In 1952, the CPD took quick action and placed a measure on the November ballot that would allow the commission to issue revenue bonds to finance projects. The ballot measure passed by a vote of 130,236 to 42,390. Two years later, the CPD began drafting plans for a new 5.5 million bushel addition to the Terminal No. 4 Grain Elevator; the addition was financed by revenue bonds. The decision was also fueled by the need for increased long-term storage of surplus wheat with a value set by the government-owned Commodity Credit Corps.[25]

The city's engineers drafted architectural plans for the new storage annex in consultation with Tudor Engineering Company of San Francisco. Grain elevator engineer specialist E.F. Carter also worked with the CPD on the installation of the car-tipper and related machinery for the addition. Drawings were completed for the rail track and road improvement at the same time. Letters in support of improvements to Terminal No. 4 were received from grain industry leaders.

Bids were let for the expansion. Construction of the new addition started in August 1954, eighteen hours after contracts were awarded to the following firms: American Pipe & Construction Co. for building the tanks ($1,276,535); General Construction Co. for removing and installing new railroad tracks ($102,820); Foothills Construction for foundation, elevator leg, and shed construction ($257,000); and Electrical Construction Co. for supplying the new electrical service ($41,700).[26]

Built east of the elevator annexes, the eight elliptical steel tanks held 5.5 million bushels of wheat, making a total capacity of 7,500,000 million bushels. Distributors and conveyors connected the new storage tanks to the other storage annexes. The elevator was touted as the largest tidewater grain elevator west of the Mississippi River.

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[25] Bruce Taylor. "Port of Portland Terminal No. 4-Grain Elevator," 1971. The Commodity Credit Corporation was a government owned and operated entity created to stabilize, support, and protect farm income and prices. The entity also helped maintain balances and adequate supplies of agricultural commodities and aided in distribution.

[26] "Construction Men Begin Elevator Job, Hope to Be Ready for Wheat in October." *Oregonian*, 27 August 1954, p. 5.

Cargill, Inc., The New Leasee

Cargill, Inc., one of the largest and oldest grain companies in the U.S., made its move into the PNW markets in 1954 when the company bought the capital stock of Kerr-Gifford, Inc. Operating the Terminal No. 4 Grain Elevator was part of Cargill's plan to expand the company's presence in the PNW and capture more of the wheat export trade. The company emerged as a major international merchandiser and processor of agricultural products. Cargill also developed better transportation networks and grain elevator systems that enabled the company to more efficiently export wheat. The lease of Terminal No. 4 Grain Elevator was a key piece of Cargill's business plan; however, private grain elevator operators objected to the Cargill lease. A November 29, 1955, article in the *Oregonian* states members of the CPD met with private terminal owners in Portland to discuss operating problems and quell concerns that the CPD was competing with the private sector.

The Agricultural Trade Development and Assistance Act, Public Law 480 (PL 480), was enacted in the same year Cargill acquired Kerr-Gifford. The Act allowed the sale of surplus agricultural commodities to foreign countries for payment in local currencies, the donation of food supplies to disaster areas and welfare organizations, and the barter of surplus U.S. farm products for goods required by the national stockpiles of the U.S. or by U.S. government overseas operations. These acts stimulated the export of surplus wheat to foreign countries; Cargill profited by the passage of the Act, as did others in the industry. Oregon was the first state to actively promote U.S. wheat to Pacific Rim countries in the 1950s.

Under Cargill's lease agreement, the CPD continued to upgrade the grain elevator. A grain car tipper was installed that permitted railroad cars to be emptied in six minutes. The new tipper, along with the older system, tripled the amount of wheat that could be unloaded at the facility. The elevator's electrical system was upgraded, the two top garners for weighing wheat were enlarged to allow more efficient grain receiving. Additional grain washers were installed, and the facility was rendered "bird and rat proof." Terminal No. 4 was again a "beehive" of activity.[27]

Around 1957, a new millwright shop was completed along with a pneumatic grain off-loader for barges (capacity of unloading 8,000 bushels an hour). The new airveyor (vacuum system), the older airveyor, and conveyor belt were moved to a location where the two machines worked together, tripling the speed barges were off-loaded. In 1958, a new grain ship-loading gallery was completed, replacing the original. The loading capacity was once again increased (see supplemental drawings).

Additional plans were made to increase productivity by constructing a new pier and unloading tower that would discharge bulk cargo from vessels into rail cars, trucks and barges. The new pier, completed in the early 1960s, substantially decreased off-loading time again (see supplemental drawings).

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[27] Ibid., (June 30, 1956) 8.

Expanding Foreign Markets

In late 1950s and 1960s, the CPD aggressively marketed to foreign countries, substantially increasing the amount of wheat shipped and promoting the benefits of the city's Portland facility. With cooperative marketing strategies and promotion by regional wheat organizations such as the Western Wheat Association, Portland again emerged as the largest grain exporter on the Pacific Coast.[28] The wheat was shipped to Portland by barge (65%), rail (25%), and truck (10%).[29] In 1958, over 35 million bushels of wheat were shipped from Portland, compared to just under 15 million from Vancouver, 13 million from Seattle, 11 million from Longview, 10 million from Tacoma, and about 2.5 million from all of California's ports.

The Western Wheat Association established markets and offices in Asian countries, dramatically increasing demand for U.S. wheat. Many countries were buying wheat with hard currency, and Third World countries were purchasing wheat through the subsidized PL 480 program. Japan was one of the first countries to buy large quantities of wheat followed by India, Pakistan, Taiwan, Korea, and the Philippines. These foreign exports were vital outlets for American grain producers. Over 90% of PNW wheat was exported to Pacific Rim countries. During this time, six U.S. firms dominated the U.S. wheat trade: ADM, Bunge, Cargill, Continental, Louis Dreyfus, and Peavey. [30]

To meet the demand, producers worked at increasing yields by improving wheat varieties and expanding the use of irrigation, pesticides, and fertilizers. These new production technologies helped sustain the high rate of growth in world wheat exports. Many developing countries began consuming more wheat during the late 1960s and 1970s. Japan began importing more wheat as the country slowly shifted from an agricultural to industrial-based economy. Japanese trading companies became more prominent in the international wheat trade; some established offices in the PNW as a way to cut sales costs. These companies bid on the weekly wheat allotments set by the Japanese government and purchased wheat from various producers worldwide. The wheat was then sold back to the Japanese government, who then sold the grain for various uses in the country.

By the late 1960s/early 1970s, CPD faced challenges as new ways of shipping emerged. Seattle captured the container business, surpassing Portland and other West Coast ports in bulk cargo shipping. The ports of Seattle, Tacoma, and Oakland received imports once heading to Portland. This shift and the increase demand for PNW wheat prompted Portland's political and governmental bodies to focus on regaining the port's status as a leading West Coast port.

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[28] *Annual Report of the Commission of Public Docks of Portland, OR* (June 30, 1955) 16.
[29] *Oregonian.* August 30, 1966.
[30] Agricultural Experiment Station, OSU, Corvallis. "Pacific NW White Wheat Exports During the 1960s." November 1970. Special Report 314.

Merger and Modernization

In 1971, Oregon Governor Tom McCall urged the PPC and CPD, the managers of Portland's waterfront, to consolidate into one unified body. That year, the two commissions merged and became known as the Port of Portland (Port). The consolidation was, in part, a response to the need for more aggressive actions to capture maritime trade. The newly-formed Port commission worked on economic development and a unified vision for the Port,[31] which included updating their various facilities.

One of the first reports the Port published was a 1971 feasibility study, prepared by Marshall, Barr, & Pacquer, to determine whether the Terminal No. 4 Grain Elevator could be modernized and updated to the level of Seattle's new automated grain elevator. The report outlined the major components of the modernization project that included adding a new 2,500 ton (approximately 83,000 bushels) an hour ship loading gallery on the west face of Pier 1 (Berth 401), installing a 1,000 ton (approximately 34,000 bushels) an hour barge unloading marine leg, and updating the track shed. The report also specified the addition of new automatic scales with upper and lower garner weighing bins to help expedite the flow of grain through the system. The Port planned on financing these updates through revenue bonds. Although these updates did not occur until the mid-1970s, the Port continued to search for new markets for PNW wheat.

The Port was the first U.S. city to ship grain to the Peoples Republic of China in 1972, and two years later, the Port expanded further by opening offices in Tokyo, Hong Kong, Korea, and Washington State. Portland's wheat exports accounted for almost 30% of the nation's wheat trade. Wheat exports peaked during the 1970s, due to reduced harvests throughout the world and increased worldwide consumption in developing countries (increased 35% from 1963-1976).[32] Urbanization, worldwide population growth, and a shift in preferences to wheat over other grains contributed to the demand for more U.S. wheat.

The Port responded to the increased demand by investing in a new grain elevator. In June 1974, the commission gave approval to Cook Industries to erect a grain elevator and dock on a 40-acre parcel along the Willamette River in the Port's Terminal 5, the Rivergate Industrial Park. The new 1.5-million bushel terminal grain elevator, completed in 1976, was the first new grain elevator built in Portland since 1962, and was one of the most automated grain facilities in the nation (in 1978 Columbia Grain Co. assumed Cook Industries' lease for the grain elevator).

In 1974, the Port also approved $12 million in revenue bonds to finance modernization of the Terminal No. 4 Grain Elevator. These Terminal No. 4 improvements were part of a new lease agreement that the Port negotiated with Cargill, Inc., operators of the grain elevator. The grain elevator and loading systems were updated. A new 2,500-ton an hour ship loading gallery was built along Pier 1 (Berth 401) and a new steel pile platform pier was constructed

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[31] In 1973, the Oregon Legislature expanded the Port's service area to include Washington and Clackamas counties.

[32] Letter dated November 19, 1973 to Clay Myers, Secretary of State from Robert F. Wallace, President of the Port Commission. Port of Portland archives.

in front of the timber pier. A grain un-loader manufactured by PECO and associated tower were built. The new system was considered state-of-the-art technology and increased the efficiency of unloading barges. The grain was carried by an enclosed overhead conveyor belt to the operating house for weighing and batching before storage.

New automatic scales with upper and lower garners bins were installed. Improvements (some automated) were made to the existing conveyor belts, elevator legs, valves, and trippers. New pulleys, motors, and belts were installed on top of the operating house on either side of the 1950s corrugated roof top addition. The outdated electrical substation was replaced, installing an underground service with increased capacity. The dust collecting system was upgraded to meet current codes and safety regulations. A separate office building, constructed west of the grain elevator, functioned as a control center for the automated elevator system that reduced the number of people operating the elevator (from approximately 30-35 people to 15 people).

The Terminal No. 4 Grain Elevator maintained its status as one of the largest elevators in the western U.S. One-third of the nation's wheat exports were shipped through the Port's grain elevators and privately-owned elevators including Bunge Grain, Louis Dreyfus and Continental Grain.

Shifting Markets: The 1980s and 1990s

By the late 1970s, the United States was the world's second largest wheat producer; the Soviet Union was the first.[33] This trend began to shift in the 1980s. While the rate of increase in wheat production slowed in the U.S. and Russia between 1982 and 1991,[34] China maintained its rate of increase and became the world's largest wheat producer. Wheat production in India and Pakistan also increased. In the United States the gradual reduction in wheat production was primarily due to competitive supply markets, higher interest rates for farmers, and other worldwide economic factors, particularly the recession in Asian countries. In response to the wheat market downturn, the Wheat Marketing Center (WMC) was established in Portland.

The WMC's mission was to conduct research on wheat classes, to provide a bridge between customers and wheat producers, to partner with the various wheat groups and producers, and to respond to the changing demand for the use of different wheat types. Once again, Oregon led the way in developing strategies for marketing PNW wheat.

Japan began buying more wheat (especially soft winter wheat) and continued to be a major economic factor in the world and U.S. wheat markets. The Japanese government strictly regulated grain imports, specifying the amount of grain that Japanese trading companies could purchase. The trading companies bid on portions of the weekly allotment, bought the

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[33] University of Saskatewan. "Winter Cereal Production." In 1978, the United States was the world's second largest producer followed by the European Economic Community and China, Canada, Australia, Argentina, India, Pakistan, and Turkey.

[34] Ibid.

wheat from various countries, and sold the grain back to the Japanese government who acted as a middle person, selling the grain to Japanese refiners. Japan also started selling U.S. wheat to other Asian markets. To meet the demands of the changing markets, the Port developed a strategic long-range plan for their facilities, one of the first comprehensive plans completed for a U.S. port.

Columbia Grain Inc., leasees of the Rivergate Terminal No. 5 grain elevator, expanded the facility by adding 2.5 million bushels of storage (1981 to 1983), and later completed a major re-automation program for the facility (1991). Cargill renewed its lease of the Terminal No. 4 Grain Elevator. An article in the August 1991 volume of the *Oregon Business Journal* stated,

> *The Port and Cargill will share equally in $1 million of capital improvements to the elevator. Terminal No. 4 has an 8.1-million-bushel capacity and is the largest grain elevator on tidewater west of the Mississippi. Cargill anticipates increasing its annual volume from the current 65 million bushels to somewhere above 100 million bushels. Part of Cargill's plan involves entering a joint agreement in Pasco, Wash., with a barge operator and a railroad to reload grain from rail to barges in order to save transportation costs and reduce rail congestion at Terminal No. 4. Barges are used now to move most of the grain grown in Oregon, Washington, Idaho, and Montana to Portland, while Midwest grain exported from Portland arrives by rail. The port operates two of the four-grain elevators in Portland, the largest grain export port on the west coast.*

In 1995, Cargill expanded their holdings in the PNW by purchasing the 1.5 million bushel Bunge grain elevator in Portland on the east side of the Willamette River (800 N. River Avenue). The company needed additional storage space to service the growing wheat export business to the Pacific Rim countries. More than a third of the wheat grown in the U.S. was shipped through Portland's grain elevators; more than two billion bushels of wheat were shipped in the United States for domestic and export destinations (1992).[35] Cargill also invested in the developing beet pulp pellet market by retrofitting a portion of the Terminal No. 4 Grain Elevator for handling and storage of pellets. A metal building was added to the east side of the elevator to house the machinery that pelletized the beet pulp (machinery removed when Cargill moved from the facility). Internal conveyor systems were installed for transporting the beet pellets; specific silos were designated for pellet storage.

Wheat prices gradually increased in the first half of the 1990s. In 1995, the Port shipped 5,398,942 tons (approximately 184 million bushels) of grain, the highest volume in years; only the Gulf coast ports shipped more wheat. This upward trend was short lived. In 1996, grain exports fell almost 10 percent below previous years because of the recession in Asian countries and other market conditions. Although PNW farmers were somewhat protected by federal farm policies, the 1996 Farm Bill began a gradual decrease in price subsidies for producers.

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[35] Jill Hough, "Logistics of the U.S. Wheat Industry." Upper Great Plains Transportation Institute, October 1994.

Once again, the PNW wheat producers responded to declining markets by moving towards specialization of wheat types to meet the needs of international markets. Producers provided importers with cleaner, quality winter white wheat grown to meet specific niche markets. At that time, there were several terminal grain elevators in Portland, including Columbia Grain and United Harvest that handled wheat exports; the Terminal No. 4 Grain Elevator was still the largest.[36]

The Japanese trading companies continued to influence the PNW wheat markets in the late 1990s. Some of the trading companies gained control over key export grain elevators competing with large companies such as Terminal No. 4's leasee, Cargill Inc.

The Closure: A New Century

Grain exports from the Port of Portland declined until early 2000 when exports started gradually increasing once again, especially to China and Japan. Portland continued to take advantage of its good access to both east-west and north-south road and rail connections, and was in a competitive position for the land-based part of the wheat transport. The Port exported wheat from farms in the northwest quarter of the United States.

In 2001, Cargill and Louis Dreyfus joined together to form CLD Pacific Grain, LLC. The new company operated three large grain elevators in Portland; two that the company owned (Irving Street and "O" Dock) and the Terminal No. 4 Grain Elevator, which they leased. Two years later, Cargill terminated its Terminal 4 lease (December 2003).[37] This decision was due to a number of factors. Foremost was CLD's decision to optimize the use of the two Portland grain elevators it owned. Other factors included the high railroad freight costs due to the Terminal No. 4 Grain Elevator's limited railroad car holding capacity, environmental concerns, and cost of modernizing the facility. For the first time in 80 years, the Terminal No. 4 Grain Elevator ceased operation.

The Port sought new tenants, but to date, the grain elevator remains vacant. Over the last few years, the steel storage tanks, shipping galleries, rail tracks, and various equipment/machinery were removed. Despite closure of Terminal No. 4 Grain Elevator, the Port maintains its status as a leading exporter of PNW wheat due to the Columbia Grain elevator at the Rivergate Terminal No. 5. Terminal No. 4, conceived as the Port's first multipurpose public terminal, remains an active marine facility with seven ship berths capable of handling a variety of cargoes including autos, fertilizer, forest products, steel, and dry and liquid bulks.[38]

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[36] Major grain elevators included and capacities: T-4 (8,200,000 bushels.); United Harvest, Vancouver (5,000,000 bushels); Rivergate T-5 (4,000,000 bushels); CLD Pacific Grain "O" Dock (1,600,000 bushels); and CLD Pacific Grain Irving Street (1,400,000 bushels), BNSF Grain Elevator Directory, 2009.

[37] *Daily Journal of Commerce*. Thursday, August 5, 2004.

[38] Since the 1930s, International Raw Materials, Inc. (IRM) has maintained tanks for fertilizer storage at the terminal.

PART II. ARCHITECTURAL INFORMATION

A. General Statement

1. **Architectural character**: Completed in May of 1920, the Terminal No. 4 Municipal Grain Elevator was built as three distinct interconnected concrete buildings: track shed, operating house, and storage annex. Subsequent additions included two large storage annexes built in 1930 and 1954. The 1930 storage annex was comprised of concrete bins and the 1954 addition included eight metal grain storage tanks (demolished 2008).

   The track shed, about 28' high, has three bays for receiving and loading grain into railroad cars and a connected car tipper on the south facade. The 182'-0" high operating house is located between the track shed and the two storage annexes. Penthouses were added to the operating house over time. The 1920 storage annex, about 97' high, is located on the north side of the operating house, and has 63 main cylindrical storage bins. The 1930 storage annex, which is north of the original annex, is slightly larger, with 72 main cylindrical bins. Enclosed conveyor galleries connect the storage annexes and the operating house. Various shipping galleries (currently being removed) extend south and west from the operating house. A corrugated metal building, used for an office, was added on the east side of the operating house in the 1970s.

2. **Condition of fabric**: The grain elevator retains much of its historic fabric, and, overall, the building is in good condition. All major ground-level foundations and above superstructures remain intact and have few visible structural deficiencies. The basement floors at the lowest elevations have standing water in many areas, but the main basement level, in the operating house and beneath the track shed, are predominantly dry. Many of the facility's mechanical grain-handling equipment appear to be intact.

B. Track Shed: Exterior Description

The track shed was designed primarily to unload wheat from rail cars and trucks. The grain was dumped through the track shed's floor into the hoppers, and funneled onto conveyor belts that transported the grain to the operating house. The track shed was also used to load cars with wheat.

1. **Overall dimensions**
   Foundation: 57'-11" (north-south) x 151'-0" (east-west)
   Height: 28'-0" at shed roof junction with operating house south facade.
   Roof monitor dimensions: 38'-0" x 15'-0"

2. **General**: The board-form concrete track shed is on the south façade of the operating house. The track shed has three bays for loading and unloading railroad cars. Originally, rolling steel doors, on both the east and west façades, sheltered the tracks shed openings,

approximately 14' x 22'.[39] Historically, only two sets of tracks entered the track shed; through the northern and southern openings. The center bay opening was used for unloading sack grain and had an interior platform with three sets of hinged trap doors for dumping the grain.[40] Both the northern and southern bays had track hoppers above the three conveyor belts located in the basement. By 1954, the central bay was opened and a third set of tracks installed because bulk shipping had replaced sack shipping. The truck tipper, built prior to 1950, is in a metal shed on the south façade of the track shed.

3. **Walls and Openings:** The track shed walls are a combination of concrete and brick. The southern façade has eleven, 2'-0" square, concrete columns set approximately 15' on center. Between these columns are brick walls laid in common bond covered with a thin cement skim coat.

   The track shed has three bay openings on the east and west facades. The south bay opening appears to be unaltered. Originally, the central bay had concrete end walls with small loading dock opening centered below two, steel multi-light windows. This bay was used for unloading sack grain. The end walls and loading platform were removed when tracks were added to the central bay in the 1950s. The central and northern bay openings were later enlarged to accommodate bigger rail cars. This is evident by the saw marks around the concrete openings. The south façade of the track shed has ten steel, multi-light windows where the upper-central section forms a pivot window that opens to provide ventilation.

4. **Roof:** The concrete shed roof covering the track shed slopes slightly downward from north to south. There is a slight eave overhang that is capped with metal flashing. Large dust collector cyclones have been mounted on the roof.

   The roof historically had three monitors that measured 38'-0" x 15'-0". The west monitor is intact, but the center and east monitors were removed to accommodate machinery. The monitor is attached to the conveyor gallery that once connected the grain elevator to Pier 1. The monitor shed roof slopes down to the west. Historically, the monitor had multi-light windows on the east, south, and west facades. Currently, the windows are covered with corrugated panels.

C. **Track Shed: Interior Description**

1. **Structural system:** The board-form concrete structural system is reinforced with round rebar. According to the original plans, the track shed's foundation slab is reinforced with 1", ¾", and ½" rebar placed at 1'-0" to 1'-6" intervals.

2. **Foundation:** The track shed foundation, comprised of 394 piles in 11 rows, 15'-0" on center, extending south to north. Additional piles are located between these rows under

[39] First Floor Operating House and Track Shed, Historic Drawings, 1918. Witherspoon-Englar Co. File 166, Drawing No. 518.
[40] General Layout, Historic Drawings, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 508.

the south façade and more pilings beyond the building edge. Driven approximately 40' to 50' deep, each pile was designed to carry a load of twenty-five tons. The piles are capped with a reinforced concrete slab, 3'-0" thick.

Between the capped piles and basement floor, nine rows of eight concrete columns extend north-south in the track shed's sub-basement. These large square columns start at an elevation of 7'-5" above sea level and extend to the basement floor at an elevation of 17'-5" above sea level. The columns measure 2'-0" x 2'-0" and 2'-6" x 2'-6". The track shed's basement floor slab is approximately 2' thick including a 6" waterproofing coating. The majority of the floor rests at the elevation of 17'-5", but smaller sections of the basement floor (one at the south wall juncture and another aligned with the operating house's south wall) have elevations as low as of 13'-5" above sea level.

3. **Basement:** The track shed basement walls are constructed of board-form concrete and rows of concrete columns that extend north-south. The concrete columns align with the sub-basement columns below, and the track shed columns and track rails above. The columns under the track rails are 1'-6" square, and columns below the track shed are 2'-6" square. The track rail columns are connected by 2'-6" beams that extend east-west. The columns, spaced 15' apart, are aligned south-north with columns 2 through 9 of the operating house.

   The west end of the basement contains rail car pulling machinery. East of the car puller, a concrete dump hopper, about 15' x 57', extends from the south basement wall to the south edge of the operating house. The hopper funnel begins 2'-6" below the basement ceiling; approximately 9" thick concrete wall angles at 45 degrees down to ten spouts positioned above the 36" wide receiving conveyor belt. Two more dump hoppers and conveyors are below the track shed.

   The three conveyors extend from the most southerly section of the track shed basement to the three receiving legs in the basement of the operating house. An east-west conveyor extends between the south end of the center and east receiving conveyors. Two additional east-west conveyors extend between the north ends of the three receiving conveyors. Additional machinery was added over the years.

4. **Ground floor interior:** The ground level of the track shed is 32'-0" above sea level. Three sets of tracks extend through the three bays of the track shed. On both sides of the center track, there are eleven square concrete columns that are aligned with the structural system below. Between each column there is a board-form concrete half wall, approximately 2' high. Above the half wall, over 10' from the ground, a concrete platform with a metal railing extends the length of the track shed. Motors and other machinery on the platform once operated the power shovels that emptied the grain from the boxcars (removed).

D. Operating House: Exterior Description

The operating house was central to the elevator's operations. The grain was distributed, sorted, washed, weighed, and stored in the operating house. These activities took place on the various floors, which included the first floor, storage bins, and distributing, transfer, scale, garner, and top floors, and the penthouse additions.

1. **Overall dimensions:**
   Foundation: 46'-2" (north-south) x 166'-2" (east-west)
   Height: 182'-0" from ground level to the top of the concrete roof (this measurement does not include the more recent penthouse additions)

2. **General**: Rectangular in plan, the operating house measures 166'-2" east-west and 46'-2" north-south, and is constructed of reinforced board-form concrete. The track shed is connected to the south façade and three conveyor galleries, at a height of about 85', lead to storage annex #1 on the north side of the operating house.

3. **Facades:** The south and north facades are divided into eleven bays, separated by slightly projecting concrete pilasters, about 15' on center that extend the height of the building. The east and west façades are separated into three bays. A projecting band of concrete extends around the perimeter of the building at the cornice; this detail is the only decorative element on the grain elevator. Multi-light windows are between the pilasters on the upper floors. According to the original 1918 drawings, the walls between the projecting pilasters are 8" thick.

   North Facade: The north façade has a number of electrical conduits extending from the horizontal band at the roof to the electrical equipment room located in the former washer room, a 1924 addition that required many of the north façade first floor windows to be filled in with concrete. A cyclone-shaped dust collector is above the former washer room that has various ducts between the first and distributing floors. Four cyclone dust collectors are mounted on the north façade at the upper floor levels with associated pipes.

   ***East Facade*:** The main entrance to the operating house is centered on the east façade, approximately 4' above ground level. Metal stairs lead to a concrete slab the height of the first floor level. A large metal door, north of the main entrance, leads into a smaller room designated as the "Foreman's room." A separate corrugated metal office building is attached to the east side of this platform (added in the 1970s). Between the first floor and distributing floor on the east facade, three metal walkways lead to meters that monitor the conditions of the six bin rows.

   South Facade: Above the track shed, the south façade has two ducts that connect to windows on the distributing floor. Three metal cyclone shaped dust collectors are attached to the lower portion of the south façade, above the track shed and the concrete conveyor gallery. At the eastern edge of the south façade, just above the track shed, there is a square opening in the façade where a conveyor gallery once connected the operating house to Pier 1.

West Façade: A metal fire escape is on the north side of the west façade. Large rectangular openings are in the center of the façade; these were used to receive equipment into the building by a metal hoist projecting from the west edge of the roof. Openings 6'-0" x 7'-6" lead to the distributing, transfer, and garner floors, and openings on the top and scale floors have been enlarged to receive oversized machinery. All of these openings have roll over, metal doors. Windows are between the pilasters on the outer bays of the upper floors.

An elevated conveyor gallery (currently being dismantled, installed in 1975) extends from ground floor of the west façade to an operating tower and the shipping pier along the Willamette River. South of the conveyor gallery is a pedestrian entrance. Historically, the pedestrian door had large multi-light windows above, and the conveyor gallery opening was a small equipment door. The window opening above the pedestrian door has been filled in with concrete. The northern window, next to the fire escape, appears to be original.

4. **Openings:** The windows, located between the pilasters, are on the first floor and upper five floors. There are no window openings between the first floor and the distributing floor because of the 70'-0" high storage bins. Currently, all of the windows on the upper floors have been removed and the window openings have been covered from the interior with corrugated plastic sheets. The larger multi-light first floor windows are various sizes. The steel windows have a central section that pivots for ventilation. These larger windows were equipped with "catch & chain" hardware. The original windows on the upper floors were smaller rectangular, multi-light, steel sash windows with the same pivot ventilation system and hardware.[41] Originally, there were a few small windows along the base of the operating house that helped illuminate the basement level. These have all been removed and the openings have been covered.

5. **Roof and penthouse:** The concrete roof of the operating house is covered with a composite roofing material. The roof slopes slightly down to the north and south for drainage purposes. A metal railing is attached to the roof edge on the east, west, and north facades. The newer metal penthouse addition is flush with the south façade of the operating house. The metal railings connect to both the east and west sides of the penthouse.

   The penthouse was added in two stages. The central portion was built when the steel storage bins were added in 1954. The addition, two stories high, has large multi-light steel windows on the north, east, and west facades. The south façade of the center penthouse addition has two large doors. The uppermost door has a steel beam projecting from the center of the door that acts as a hoist.

[41] East Elevation, Historic Drawings, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 511.

The single story wings, attached to both the east and west façades of the center penthouse, are constructed of corrugated metal. There are no openings on the north or south façades. This portion of the penthouse was added in 1975 when the west conveyor gallery was added and much of the grain elevator was automated. On the west façade of the western wing addition, a raised pedestrian door leads to a metal-grate platform and stair to a metal door used to bring equipment into the interior.

E. Operating House: Interior Description

1. **Structural system:** The operating house has an intricate reinforced concrete construction system. The first floor ceiling is constructed with a grid system that has rebar placed every 4" to 1' depending on the location of floor and ceiling openings. The floors are 6" thick with the exception of the first floor ceiling or bin floor, which is 1'-2" thick.[42]

   The operating house is supported by a structural system comprised of rows of hexagonal columns that are about 15' on center. The columns on the lower floors measure 3'-6" and the columns on the upper floor measure 2'-8". Pilasters on the interior walls on some of the floors are half a hexagon in form.

2. **Foundation:** The foundation's footing system is comprised of 1,540 piles set in rows of twenty-two piles (north-south) and seventy piles (east-west). Each pile is driven in 40' to 50' deep for a safe load of twenty-five tons per pile. All the piles terminate at an elevation of about 5' above sea level. The piles are capped with a 3'-0" concrete slab (originally referred to as a "matt"). Historic plans show additional pilings were driven around the operating house in all directions. In many places more than 14 rows of pilings extended beyond the edge of the foundation, while in others (such as the western edge of the building) only seven rows of pilings extend beyond the buildings footprint. The concrete slab extends beyond the building's edge approximately 2'-11" on all sides. Between the concrete slab and the basement floor are 6'-0" square concrete columns that have 9'-0" wide and 2'-0" high footings. Historic plans indicate that the spaces between the columns are filled with "hydraulic fill" material.[43] These columns align with the structural system in the accessible basement.

3. **Basement:** The basement structural system is comprised which 4'-0" square concrete posts on 5'-0" square footings, 2'-5" high. The bulk of the operating house's basement floor is at an elevation of about 25' above sea level. A smaller section of the basement centered between the east and west facades (approximately the south one-third of the basement), is at an elevation of 13'-5".

   Two concrete walkways span the lower elevation and lead to the track shed's main basement floor. Three conveyor belts start at the south side of the track shed's basement,

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[42] Reinforcing plan: Garner and Top Floors and Roof of Operating House, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 526.

[43] Lower Cross Section, Historic Drawings, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 514.

pass under the concrete track hoppers, and terminate at the receiving legs in the basement of the operating house. Receiving Leg #1 is at the west end, Receiving Leg #2 is in the center, and Receiving Leg #3 is sited at the east end. The passenger elevator is near the northeast corner of the basement next to the metal grate stairs that lead to the first floor of the operating house.

4. **Ground floor:** The ground floor, about 25' high, has the passenger elevator, metal grate stairway hoist hole, and the foreman's office in the northeast corner of the building. A small belt elevator (the "manlift") is located in the northwest corner of the ground floor. At the time of construction, Receiving Legs #1, #2, and #3 were evenly spaced along the south side, and Shipper Legs #1, #2, and #3 were evenly spaced along the north side of the building. Smutters and separators were originally in the center of the ground floor but were replaced with a screw conveyor system extending east-west in the center of the floor. The conveyor is elevated approximately 3' from the ground. This system moved grain to the conveyor gallery at the west end. Above the screw conveyor is a conveyor belt accessed by a hanging metal grate walkway.

   The ceiling has metal spouts from the various storage bins above. Each spout is assigned a number that corresponds to a numbered bin, and swivels in order to direct grain to the proper chute. The first floor, and floors above the operating house storage bins, have floor to ceiling columns, spaced into three rows of eleven sections, about 15' square.

5. **Distributing floor:** The distributing floor, about 18' high, is where the wheat was dispersed into the storage bins below. The lower manlift from the ground floor ends at this floor. The upper manlift is located approximately 15' to the southeast and continues to the top floor. On the north side of the floor there are two, concrete 15' square mezzanines that once held grain separators (machinery removed).

   There are nine central grain chutes that distribute the grain from the transfer floor to the operating house bins or to the attached storage annex bins. The north side of the floor has rectangular metal shipping and washer legs that extend from floor to ceiling. The south side of the floor has receiving, separator, and smutter legs.

   The legs located on the north side of the building are named from east-west: Shipping Leg Asia; Washer Leg No. 3; Shipping Leg Europe; Washer Leg No. 2; Shipping Leg Africa; and Washer Leg No. 1. The legs located on the south side of the floor are named from east-west: Separator Leg King; Receiving Leg Washington; Separator Leg Pierce; Columbia Leg; Multnomah Leg; Receiving Leg Oregon; Smutter Leg Clatsop; New Separator Leg; Receiving Leg Idaho; and Smutter Leg Morrow.

   The distributing floor is also the main access to the bin floor of storage annex #1. Three galleries connect to the annex. Each gallery is accessed by a metal grate stairway to a small sub-floor room that houses a conveyor belt. The three conveyor belts extend north across covered galleries to storage annexes #1 and #2.

6. **Transfer floor:** Historically, the transfer floor had a single conveyor belt extending east-west through the center. Currently, two conveyor belts extend the entire length of the floor. Many of the shipping and receiving legs on both the north and south sides have been dismantled. The transfer floor, 16' high, has a raised mezzanine that is 7'-6" from the floor, and is accessed by metal grate stairways along the southwest and southeast corners. The mezzanine consists of a small path around the perimeter of the floor and a larger section through the center of the floor. Two conveyor belts are located on the mezzanine center walkway.

7. **Scale floor:** The grain dropped through chutes to the scale floor to be weighed in one of nine (15'-square) 2,000-bushel metal hoppers or in the one (12' square) 1,000-bushel hopper, set between concrete columns. Fairbanks-Morse beam scales, on the south side of the scale hoppers, registered the weight of the grain: up to 120,000 lbs. in the nine big scale hoppers and up to 60,000 lbs. in the small hopper. Each of the scales was named (east-west): Heppner, Nampa, Kobe, Moscow, Astoria, London, Portland, Tacoma, Capetown, and Seattle. Of the original Fairbanks-Morse registering beam scales, only portions of the Tacoma, Astoria, and Heppner scales are still in the facility; the others have been removed.[44] Wooden pull levers in the ceiling and in the floor by the Fairbanks-Morse scales allowed the weight operator to fill and empty the scale hoppers by opening and closing slide gates. The Moscow and Portland hoppers were replaced in the 1950s with larger round hoppers that had 8,000 lbs. of weights attached to bottom of the hopper.

   Originally, there was a bathroom in the southeast corner of the scale floor and a "weightman's" room in the center of the south wall. These rooms have been removed. Similarly, all of the receiving and shipping legs, the two stairway's leading to the transfer floor, and the cyclone dust collectors have been removed from the north side of the scales, leaving a hallway void of equipment between the passenger elevator and the emergency exit door to the fire escape. The ceilings are about 16' high.

8. **Garner floor:** Concrete walls extend east-west through the center of the garner floor, dividing the floor into three longitudinal sections, although a hallway is around the perimeter. Shipping and receiving legs were originally north and south of the central section. The shipping legs on the northern portion of the building have been removed along with some of the legs on the southern side. Some of the legs have been replaced with newer bucket lifts. A section of the central concrete wall has been cut away for the installation of a metal grain chute. The ceilings are about 15' high.

9. **Top floor:** Historically, eight shipping and receiving legs were on this floor. At the top of the leg, grain was dropped from buckets to chutes to garner hoppers. The top floor has a newer enclosed conveyor belt on the east end that extends along the center

[44] In 2008, the "Nampa" Fairbanks-Morse scale was removed from the grain elevator and stored until 2010 when the scale was placed in an interpretative display at the Port of Portland headquarters building in Portland.

of the floor for approximately 25'. This belt connects to the bucket lift on the penthouse floor above. An oil room, located in the southeast corner of the floor, was removed and most of the equipment moved to the penthouse addition above.

10. **Penthouse:** The penthouse has three leg bucket lifts on the east side of the penthouse and one on the west side. A single bucket lift is located on the second floor of the penthouse. There are vents in the south and north facades, and windows in the center section of the north façade. These windows have been painted over.

11. **Stairways and passenger elevators:**

Stairways: The operating house has a metal grate staircase in the northeast corner of the building that extends from the ground to the top floor. Each staircase, approximately 3' wide, extends along the north wall, turns, and continues along the east wall of each floor. Another staircase, located in the southwest corner of the building, extends from the distributing to the top floor. A metal stairway extends from the top floor to the penthouse through an opening cut in the ceiling.

Employees Belt Elevator: The employee belt elevator, located in the northwest corner of the building, extends from the ground floor to the distributing floor. A second belt elevator, approximately 15' to the southeast, continues from distributing to the top floor. The belt elevators were called the "lower manlift" and the "upper manlift."

The elevator belt held a number of round platforms, which a person would step on to ride to the desired floor. Originally the machinery for the belt elevator was located on the distributing floor; this machinery has been removed.

Passenger Elevator: A passenger elevator extends from the basement to the top floor. The elevator, a steel grate cage about 4' x 4' x 8', has an expandable metal lattice door and is suspended in an open elevator shaft measuring 4'-3" x 6'-8". The machinery for the elevator is located in the basement, behind (north of) the elevator shaft. On each floor, the open shaft and steel elevator guide rails are enclosed by a protective chain-link wall and safety door, which locks when the elevator is not available. A phone is located in the elevator.

F. **Storage Annex #1 (1920): Exterior Description**

1. **Overall dimensions**
Building Footprint: 105'-7" (north-south) x 135'-7" (east-west)
Height: about 101' high.

2. **General:** Completed in 1920, storage annex #1 was constructed at the same time as the operating house and track shed. The reinforced concrete storage annex is comprised of cylindrical concrete bins and a concrete penthouse.

3. **Structural system:** Storage annex #1 is constructed of board-form reinforced concrete. The bin deck was built with a grid system of straight and bent rebars. Straight bars appear to be laid in a grid with nearly two rods per foot extending both east-west and north-south, depending on the location of floor and ceiling openings. The bin deck is about 9" thick and the bin floor (top) is about 7" thick.[45]

4. **Foundations:** The storage annex is supported by 2,452 wood pilings driven 40' to 50' deep and able to carry a load of twenty-five tons per pile. The pilings are terminated at an elevation of 5'-0" above sea level. The area between piles is filled with sand and capped with a concrete slab (originally called a matt) that is about 3' thick. Pilings surround the storage annex #1 in all directions. In many places more than nine rows of pilings extended beyond the building edge, while in others (such as the northwestern edge of the building) only four rows of pilings extend beyond the buildings footprint. The concrete slab extends beyond the building line of the annex approximately 1' in all directions.

   Between the 3' slab capping the wood piers and the basement floor are cement columns, about 3' square. These columns align with the structural system of the bin walls. Plans indicate that the spaces between the columns were packed with a "hydraulic fill" or an "earth fill" material.[46]

5. **Openings:** Historically, the multi-light steel sash windows were on the top floor of the annex. Most of these windows have been altered. A few windows have been converted into vents and others have been covered with corrugated plastic panels.

   Three conveyor galleries and tunnels extend from the operating house to storage annex #1. The tunnels between the two basements are concrete, while the galleries between the operating house and the top of the annex are constructed of corrugated metal. The galleries are about 89' from the ground.

6. **Roof:** The concrete roof projects slightly from the façade of the penthouse. The hip roof slopes slightly to the east and west with a pitch of ½" to 12".

G. Storage Annex #1 (1920): Interior Description

1. **Basement:** The basement of storage annex #1 is 25'-0" above sea level. Conveyor tunnels extend underground and connect with the basement of the operating house. The conveyors carry grain from the bins to the operating house for cleaning, weighing, and shipping. Grain spouts, below the bin deck, direct the grain to the nearest conveyor belt.

2. **Bins:** The annex is comprised of nine bins (north-south) and seven bins (east-west). The 63 bins are about 15' in diameter, 85' high, with 7" thick walls. Each bin has capacity of

[45] Cross-section of Storage Annex, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 525.
[46] Lower Cross Section, Historic Drawings, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 514.

storing between 10,300 to 12,200 bushels, creating a total capacity of 675,900 bushels. There are 48 interstice bins or "star" bins that are between the main cylindrical bins. Thirty-six of these bins were used for storage. The interstice bins measure about 8' across and had a capacity of holding 2,200 bushels, making their total storage capacity 79,200 bushels. This brought the total capacity of storage annex #1 to 755,100 bushels.

3. **Bin floor (top of bins):** The bin floor is a large open area with three conveyer belts extending though the storage annex and continuing to storage annex #2. There are square concrete columns about 1' square throughout the floor about 15' on center. Each distributing conveyor belt is between metal rails that guide the tripper. The tripper drops the grain from the belt to chutes that direct the grain into the concrete bins.

H. Storage Annex #2 (1930): Exterior Description

1. **Overall dimensions**
   Building Footprint: 138'0" (north-south) x 153'0" (east-west)
   Height: about 101' high.

2. **General:** Concrete storage annex #2 was constructed in 1930. The original plans of storage annex #1 provided openings in anticipation of the construction of storage annex #2. The concrete storage annex has exposed concrete silos on all façades and a concrete penthouse that has a moderately pitched concrete roof.

3. **Structural system:** Storage annex #2 is constructed of reinforced, board-form concrete. The bin deck was built with a grid system of straight and bent rebars. Straight bars appear to be laid in a grid with nearly two rods per foot extending both east-west and north-south, depending on the location of floor and ceiling openings. The bin deck is about 10" thick and the bin floor (top) is about 4" thick. The bin floor, columns and the exterior beams were to be 2000 lb. strength concrete.[47]

4. **Foundation:** The storage annex is supported by about 2,400 wood pilings that were driven in for a safe load of twenty-five tons per pile, similar to the rest of the complex. All piles terminate at an elevation of about 13' above sea level. The piles are capped with a concrete slab that is about 2' thick. The foundation of storage annex #2 canted from the base of the bins. Annex #2 does not have a sub-basement.

5. **Openings:** The only window openings on storage annex #2 are on the top floor. There are seven sets of two windows on the east, west, and north elevations. The majority of the steel multi-light sash windows have center sections that pivot for ventilation. On the south façade there are three conveyer galleries extending from storage annex #1 to annex #2. The galleries are constructed of corrugated metal at a height of about 83'.

[47] Cross-section of Storage Annex, 1918. Witherspoon-Englar Co. File No. 166, Drawing No. 525.

6. **Walkways:** Two pedestrian walkways with pipe railings connect the two annexes. The rest of the façade has multi-light windows with pivoting center sash. At the base of the bins, on the canted footing, are metal access hatches, with smaller metal doors that open to the basement.

7. **Roof:** The concrete roof projects slightly from the façade of the penthouse. The roof slopes slightly to the east and the west with a pitch of ½" to 12". The roof is about 3¼" thick.

I. Storage Annex #2 (1930): Interior Description

1. **Basement:** The basement can be accessed from the foundation openings. The exterior openings have ladders that lead down from the hatches to the basement floor. Between the 2'-0" slab capping the wood piers and the basement ceiling (bin deck), rectangular concrete columns (9'-0" north-south x 7'-6" east-west x 17'-0" high) are separated by nine, 7'-0" wide, north-south hallways and eight 6'-0" wide east-west hallways. The shipping conveyors run through the 2nd, 5th, and 8th north-south halls; three spouts direct grain from bins to the conveyor belt. The three conveyer belts extend south through concrete tunnels to the basement of storage annex #1.

2. **Bins:** Seventy-two cylindrical bins are about 15' in diameter, 8 bins (north-south) and 9 bins (east-west). The bin walls are between 6" and 7" thick. The bins are about 79' high and each has capacity of between 10,010 to 12,684 bushels, a total capacity of 768,912 bushels. Fifty-six interstice bins or "star" bins are between the main cylindrical bins. Forty-two of these bins, measuring about 6'6" wide, had a capacity of holding between 2,300 to 2,424 bushels, a total capacity of 99,080 bushels. Together, storage annex #2 had a total capacity of 867,992 bushels.

3. **Bin floor (top of bins):** The bin floor, about 82' high, has three distributing conveyor belts that extend south to north from storage annex #1 to the north edge of storage annex #2. Each conveyor belt is between metal rails that guide the tripper. The tripper drops the grain from the belt to metal chutes that direct the grain into the concrete bins. There are 1' square concrete columns about 15' on center. A metal framed, multi-light skylight is above the center conveyor belt. A cast iron manhole cover, measuring about 2' in diameter, accesses each bin.

J. Site

Port of Portland's Terminal No. 4 off of North Lombard Street in Portland is in the St. Johns neighborhood. Terminal No. 4, a 261-acre facility on the northeastern shore of the Willamette River, is about 1.5 miles downstream from the St. Johns Bridge between river miles 4 and 5. The Tualatin Mountains (Portland Hills) are on the opposite side of the Willamette River, across from the terminal.

Terminal No. 4 is bounded to the north by the Schnitzer Steel facility, to the northeast by the Burgard Industrial Park, to the east by Union Pacific Railroad St. Johns Lead, to the south by the terminal's auto storage area and North Bradford Street, and to the west by the ordinary line of low water of the Willamette River. North Terminal Road, in the northeast corner of the site, leads to the terminal. The site gently slopes upward towards the St. Johns commercial area. Railroad tracks lead to the grain elevator, the pier and slip systems, and cargo loading areas. The grain elevator is sited in the northwest corner of the terminal, directly north of Slip 1. The flourmill, owned by the Cereal Food Processors Company, is directly west of the elevator, as is the vacant grain office building. The surface covering is primarily asphalt, gravel, and dirt.

PART III. SOURCES OF INFORMATION

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B. Architectural drawings: Digital copies of the architectural drawings of Terminal No. 4 are in the Port of Portland's Technical Reference Center in Portland, OR. The extensive collection includes original construction drawings and details of the Terminal No. 4 Grain Elevator, and subsequent alterations and additions. The collection includes hundreds of drawings.

C. Historic views: The Commission of Public Docks and the Port of Portland's Annual Reports are located in the archives of the Port of Portland's Technical Reference Center. These reports also include period photographs of the Terminal No. 4 Grain Elevator. Oregon Historical Society Photographic Collection, Port of Portland Collection, contains many photographs of Terminal No. 4, from the initial construction until the 1990s.

D. Maps and aerials:

Aerial Photographs. Terminal No. 4, 1936, 1939, 1948, 1955, 1961, 1972, 1980, and 1997. Port of Portland's Technical Reference Center collection.

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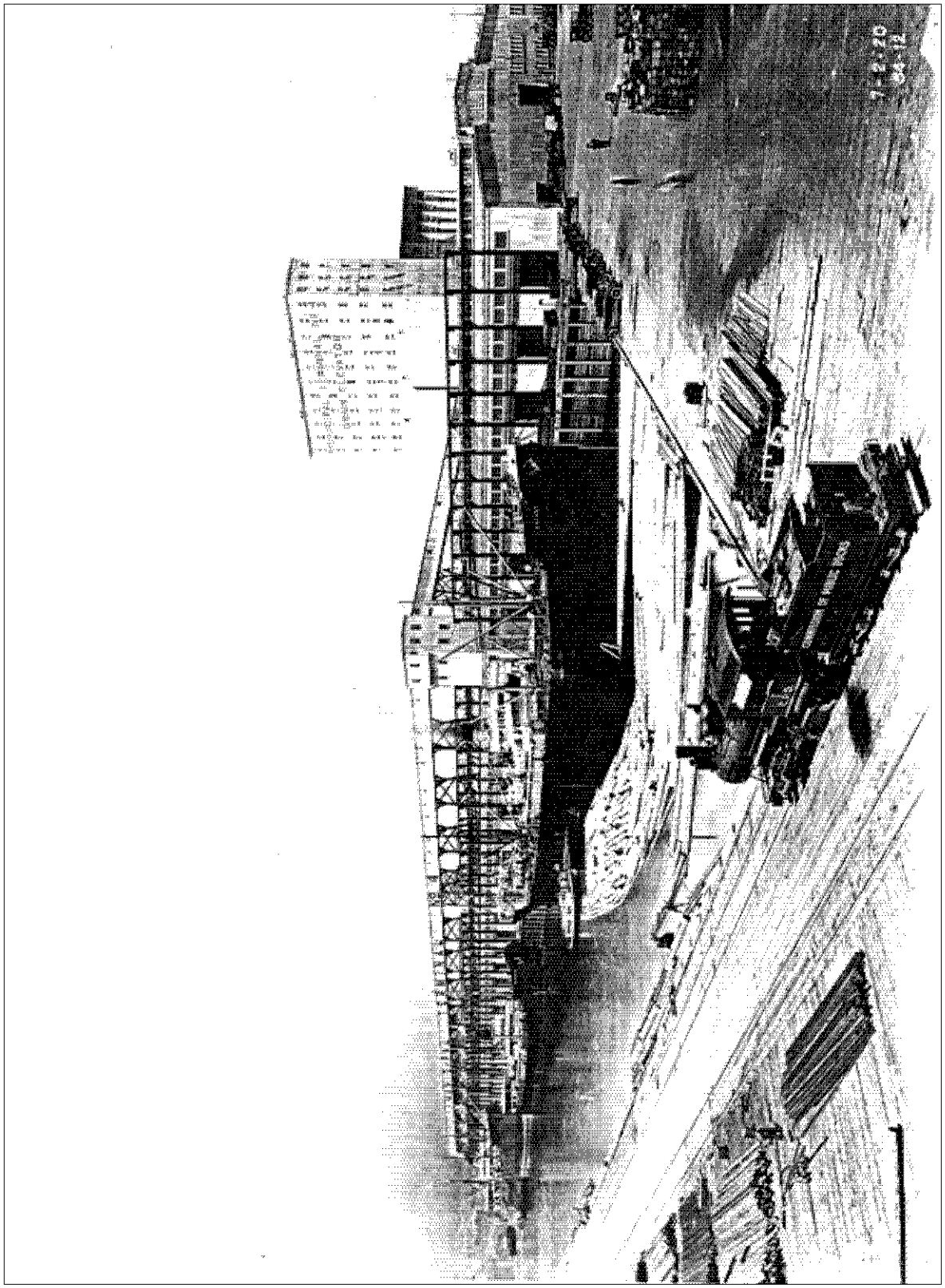
E. Supplemental material:

See page 42 of the report

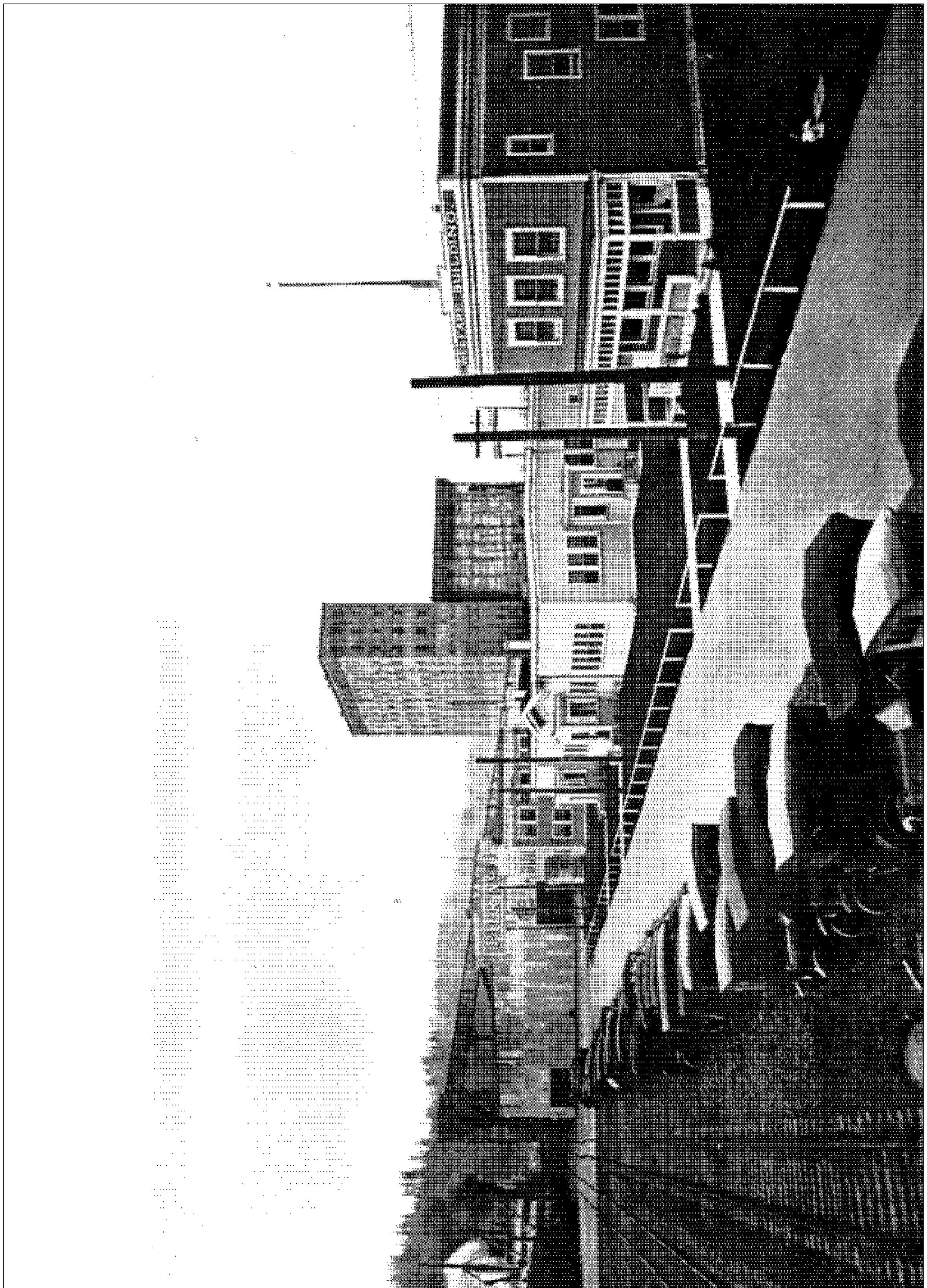
PART IV. PROJECT INFORMATION

The Portland Municipal Terminal No. 4 Grain Elevator historical report and associated field work was completed by Sally Donovan, M.S., Donovan and Associates. Donovan also completed the required large format photograph for the project and historic report; Adrienne Donovan-Boyd prepared the architectural description, and Bruce Howard assisted in the fieldwork, editing, and compiling the report. The fieldwork was completed in February and March 2010, and the report finished in August 2010. Nicole Miranda, Administrative Coordinator, Marine and Industrial Development, Port of Portland, was the project coordinator for the project.

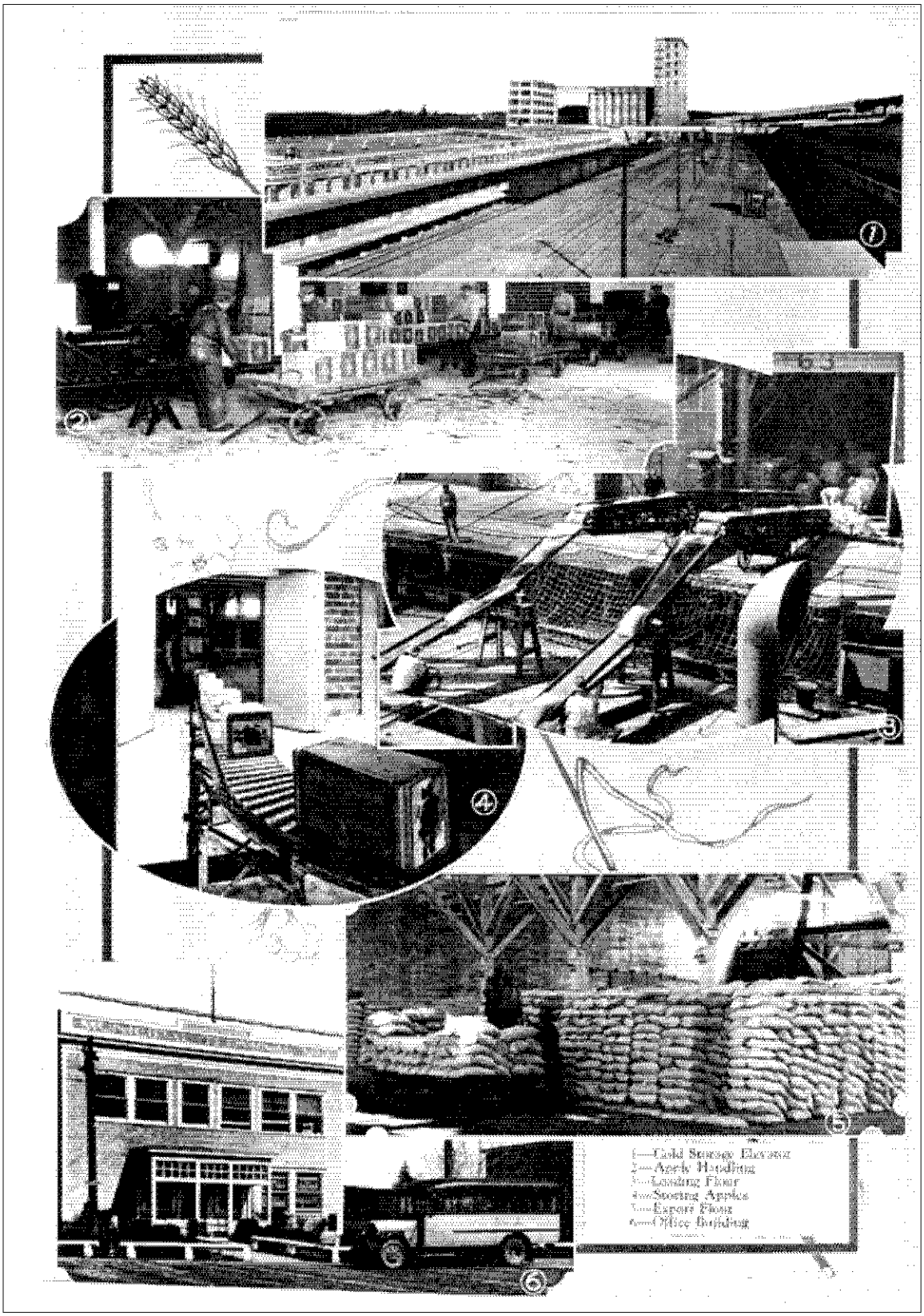
PART III. SOURCES OF INFORMATION
D. Supplemental Material



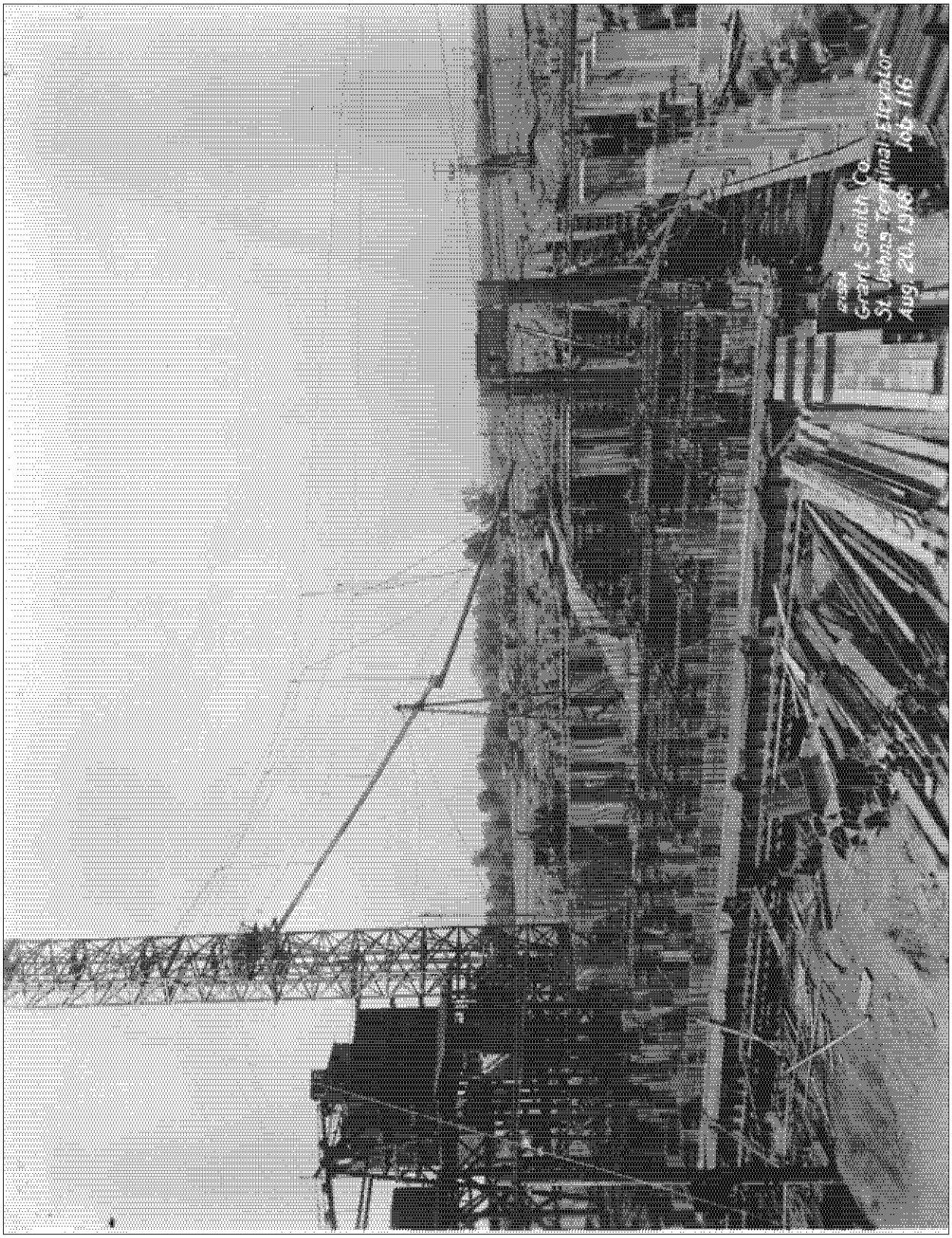
View of Pier 1, operating house, and storage annex, looking northwest from Pier 2, July 2, 1920.
Port of Portland Archive Photograph Collection



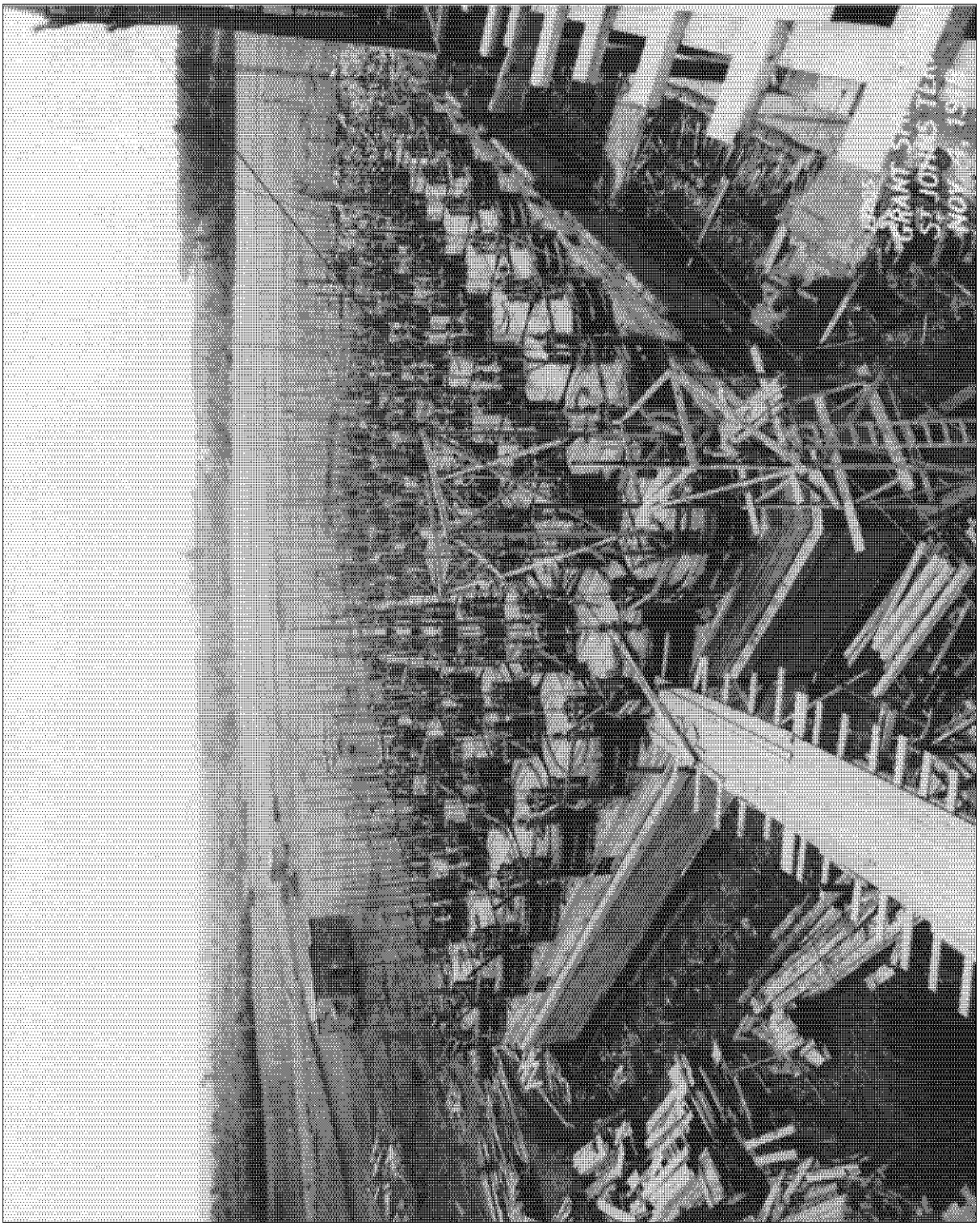
View of administration, restaurant, and welfare buildings, looking northwest, Commission of Public Docks Annual Report, 1923.
Port of Portland Archive Photograph Collection



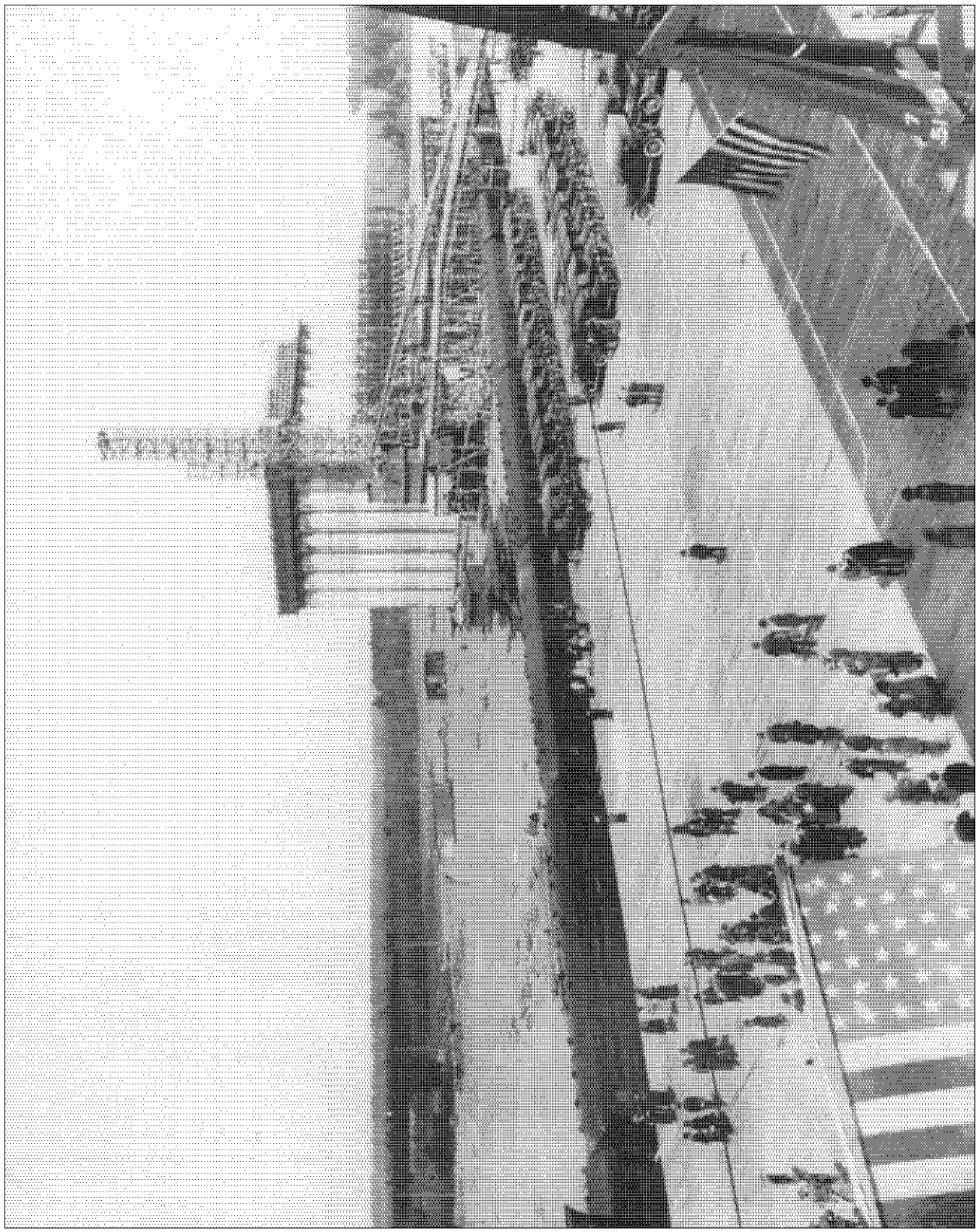
View of Terminal activities, photo collage, Commission of Public Docks Annual Report,1929.
Port of Portland Archive Photograph Collection



View of basement of track shed, operating house, and storage annex, looking north, August 20,1918.
Port of Portland Archive Photograph Collection PH T4 1918 4001 00 0003 0

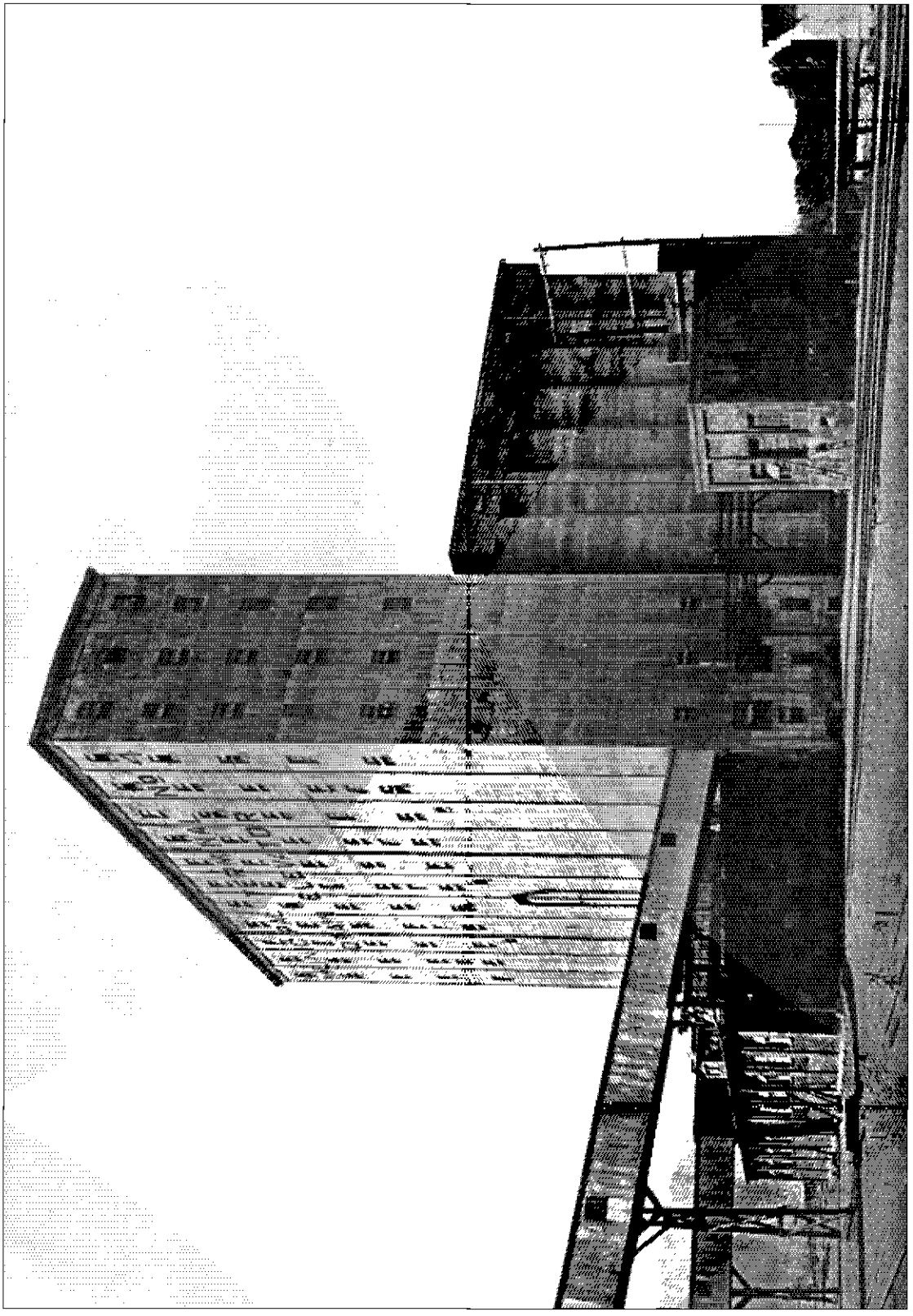


View of foundation of storage annex and beginning of bin forms, looking northeast, November 4,1918.
Port of Portland Archive Photograph Collection PH T4 1918 0011 00 0001 0

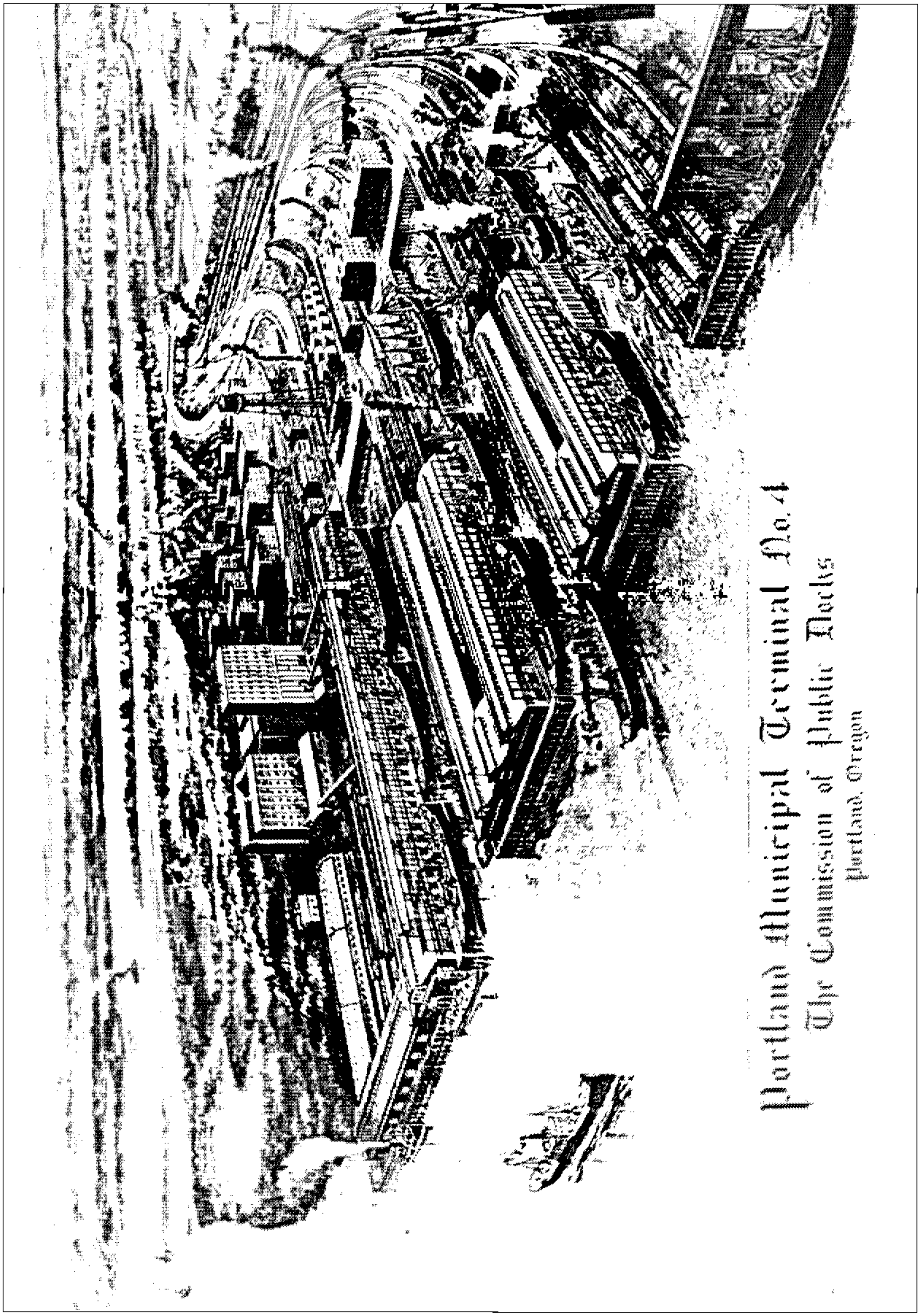


Opening ceremonies of Terminal No. 4, looking northeast at Pier 1, train, track shed, operating house, and storage annex, c. April 1919.
Port of Portland Archive Photograph Collection PH T4 1918 0011 00 0003 0

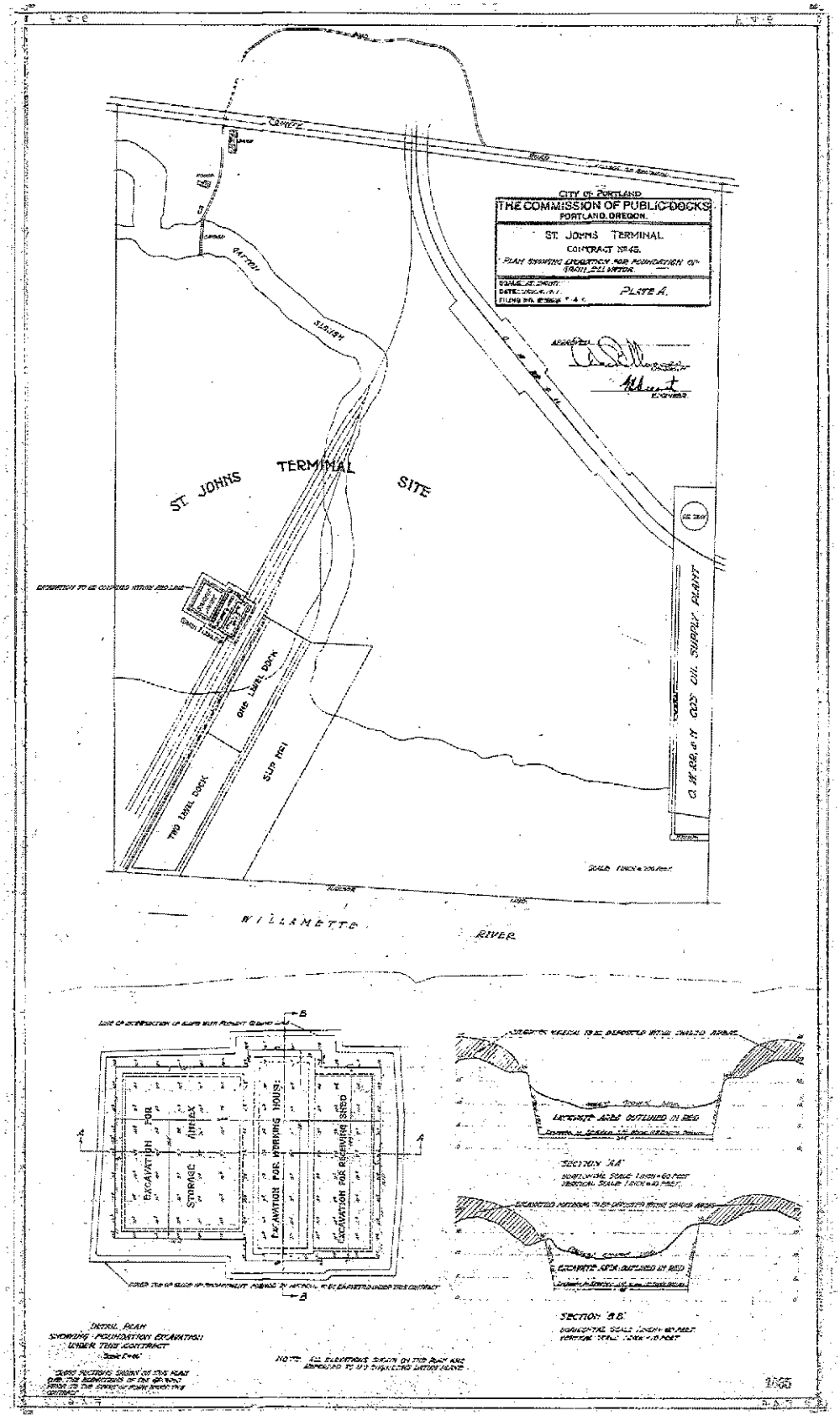
View of track shed, operating house, and storage annex, looking northwest, c. Nov. 1919.
Port of Portland Archive Photograph Collection PH T4 1919 4002 00 0004 0



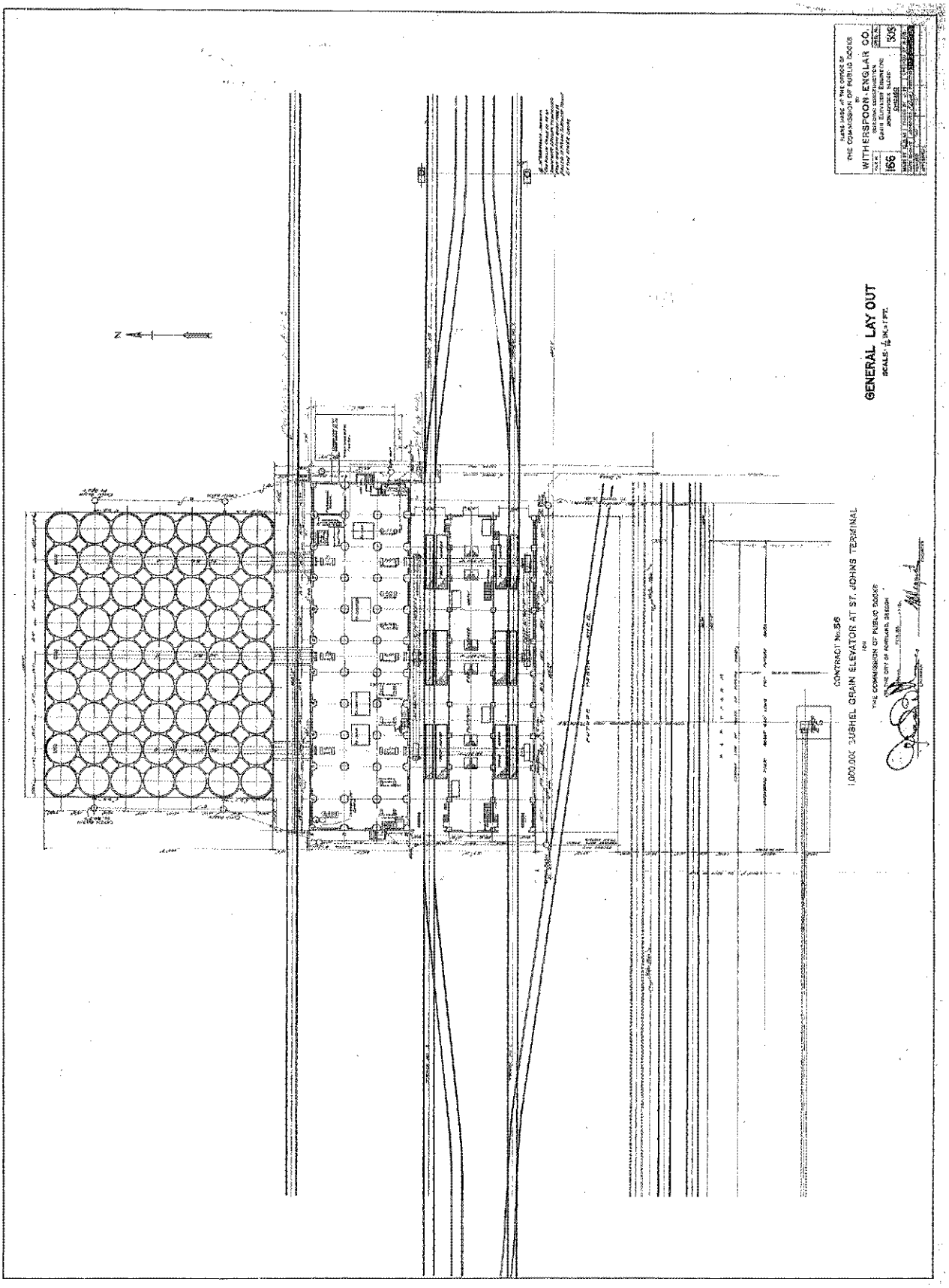
"Million-Bushel Grain Elevator, Portland Municipal Terminal No. 4," looking northwest, Commission of Public Docks Annual Report, 1921.
Port of Portland Archive Photograph Collection



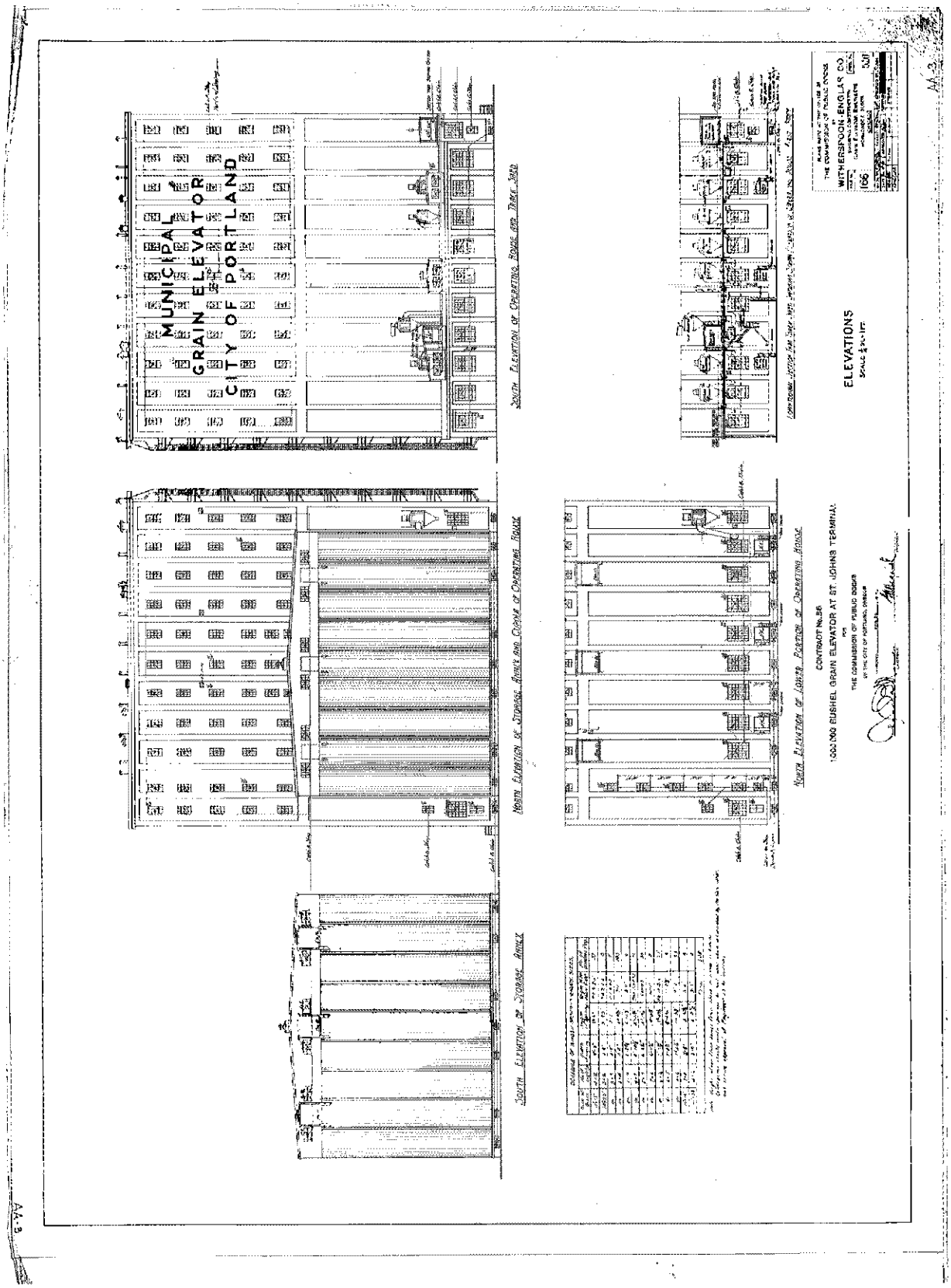
Master Plan of Terminal No. 4, Artist's Rendering, "Annual Report of the Commission of Public Docks", 1921.
Port of Portland Archive Collection



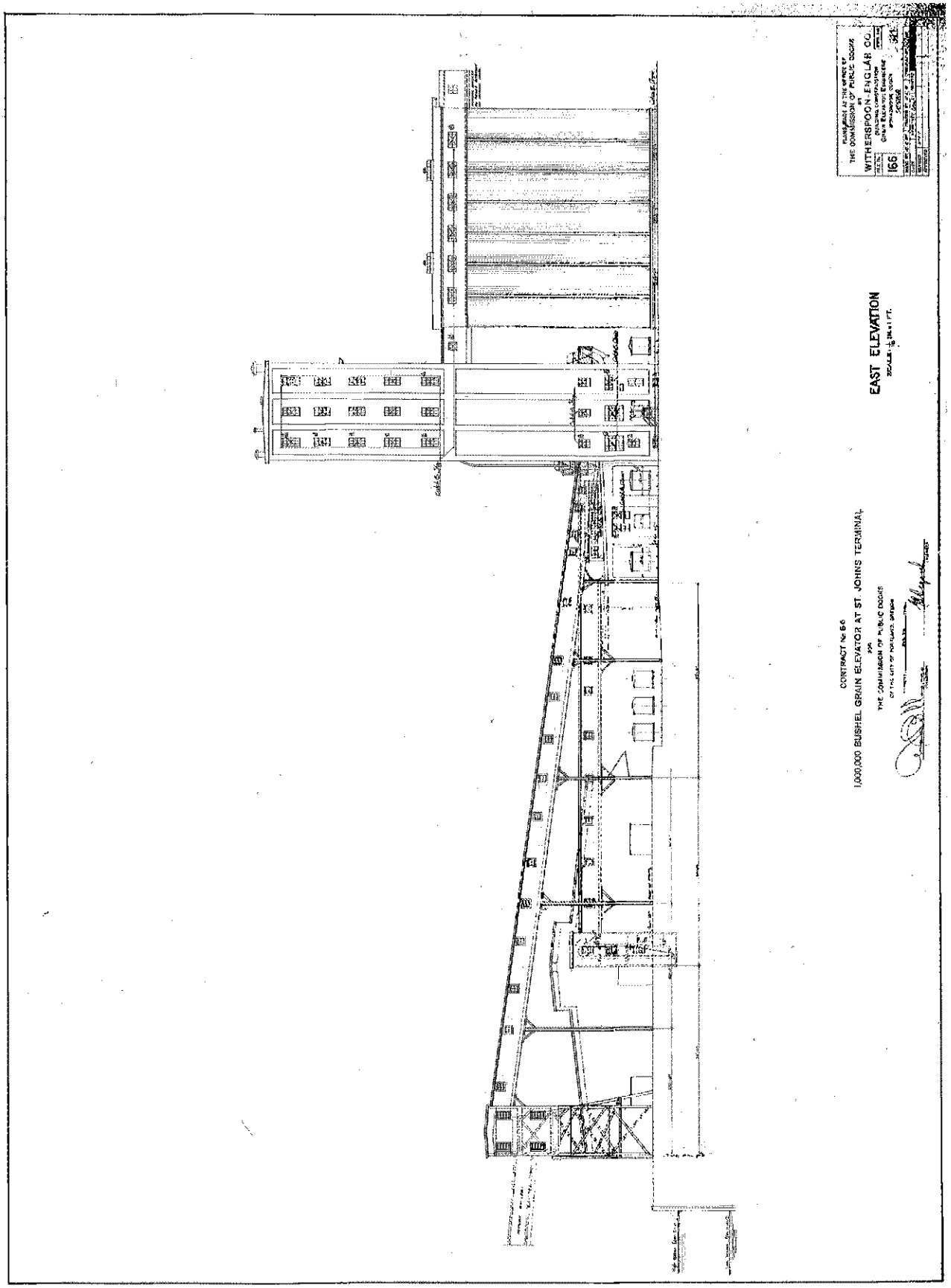
Location for Foundation of Grain Elevator at St. Johns Terminal, 1917.
Port of Portland Archive Collection CP T4 1917 0002 00 1035



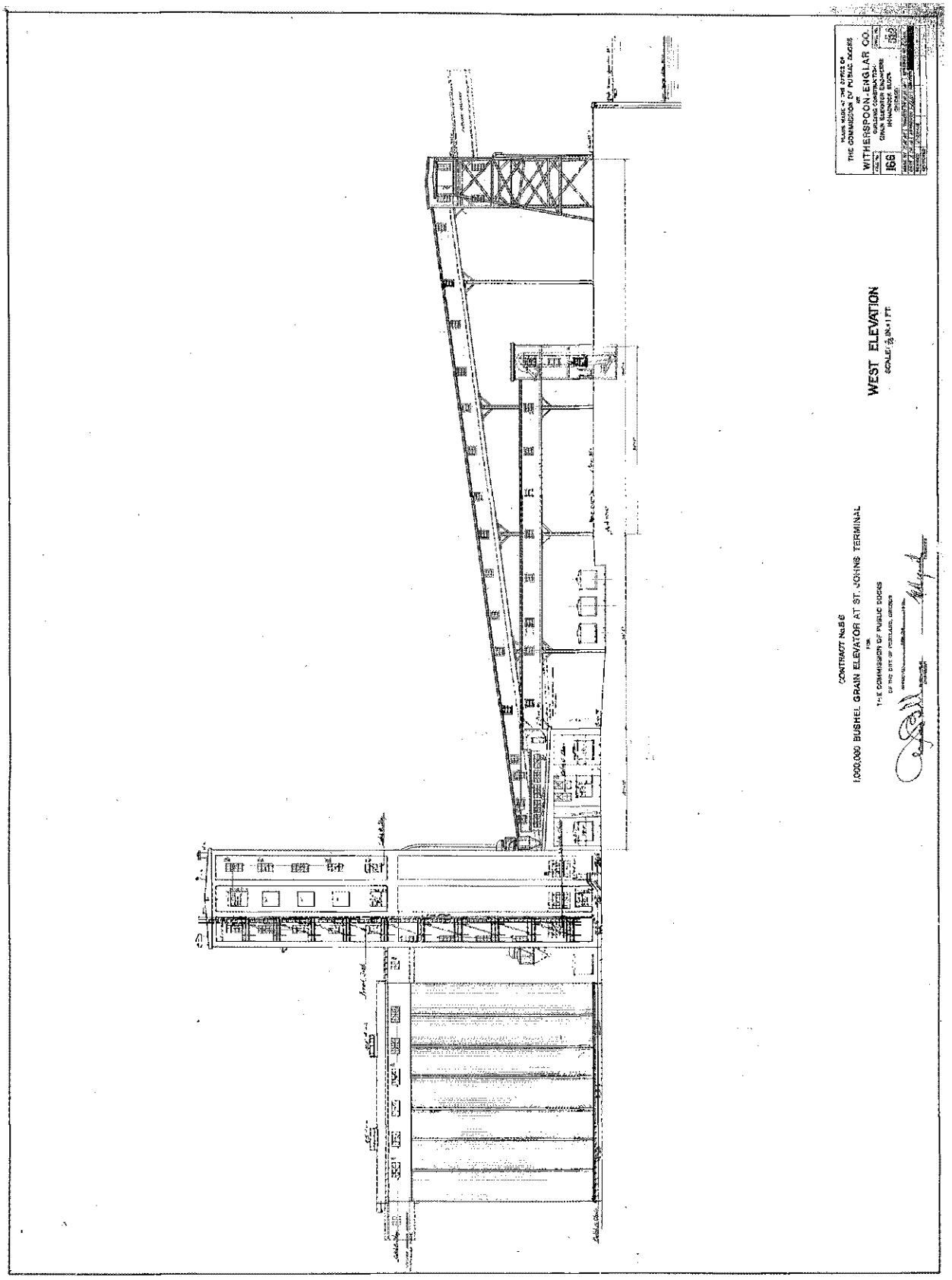
1,000,000 Bushel Grain Elevator at St. Johns Terminal by Witherspoon – Englar Co., 1917.
Port of Portland Archive Collection CP T4 1918 0003 00 0508



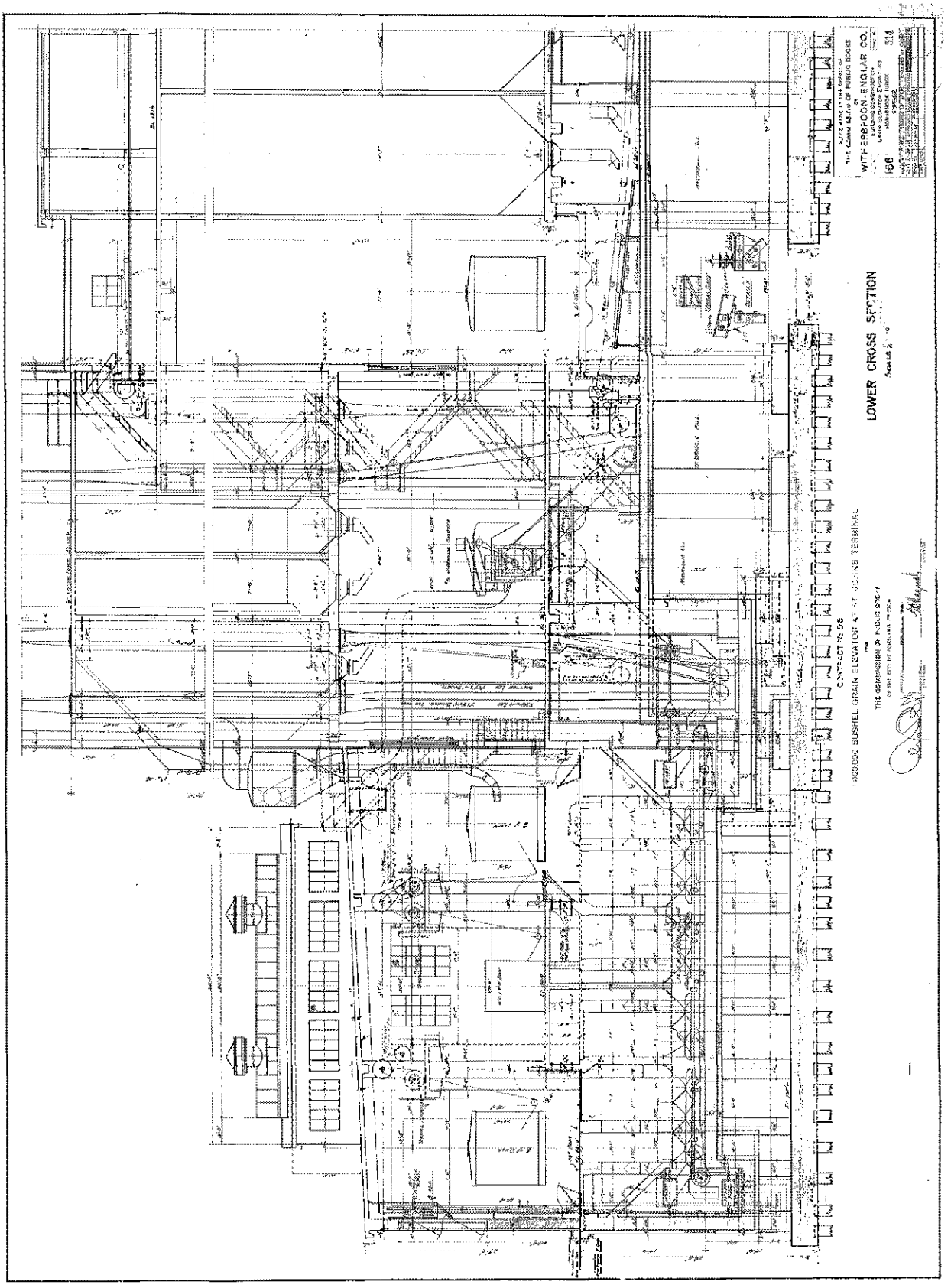
1,000,000 Bushel Grain Elevator at St. Johns Terminal, Elevations, 1918.
Port of Portland Archive Collection CP T41918 0003 00 0510



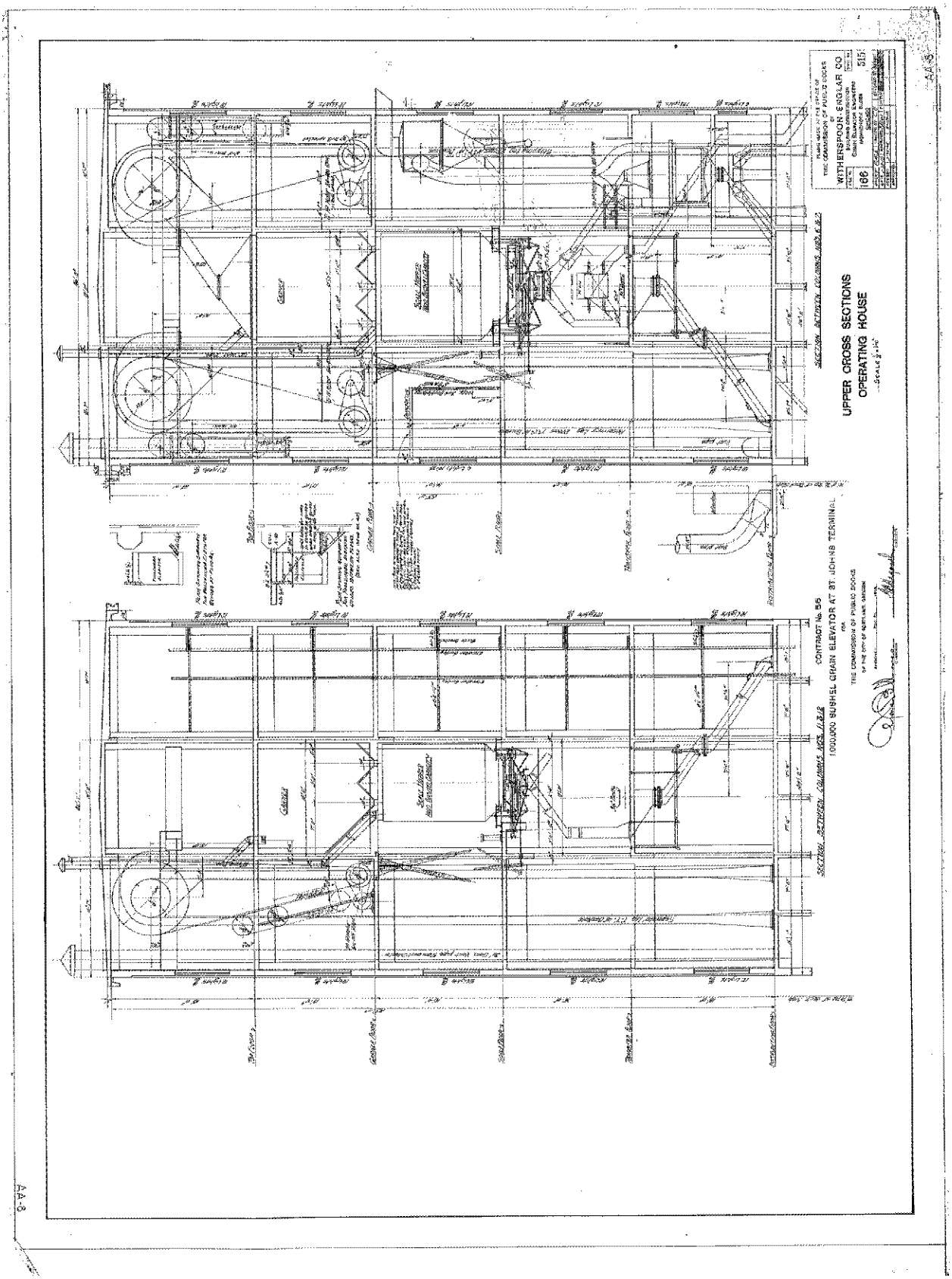
1,000,000 Bushel Grain Elevator at St. Johns Terminal, East Elevation, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0511



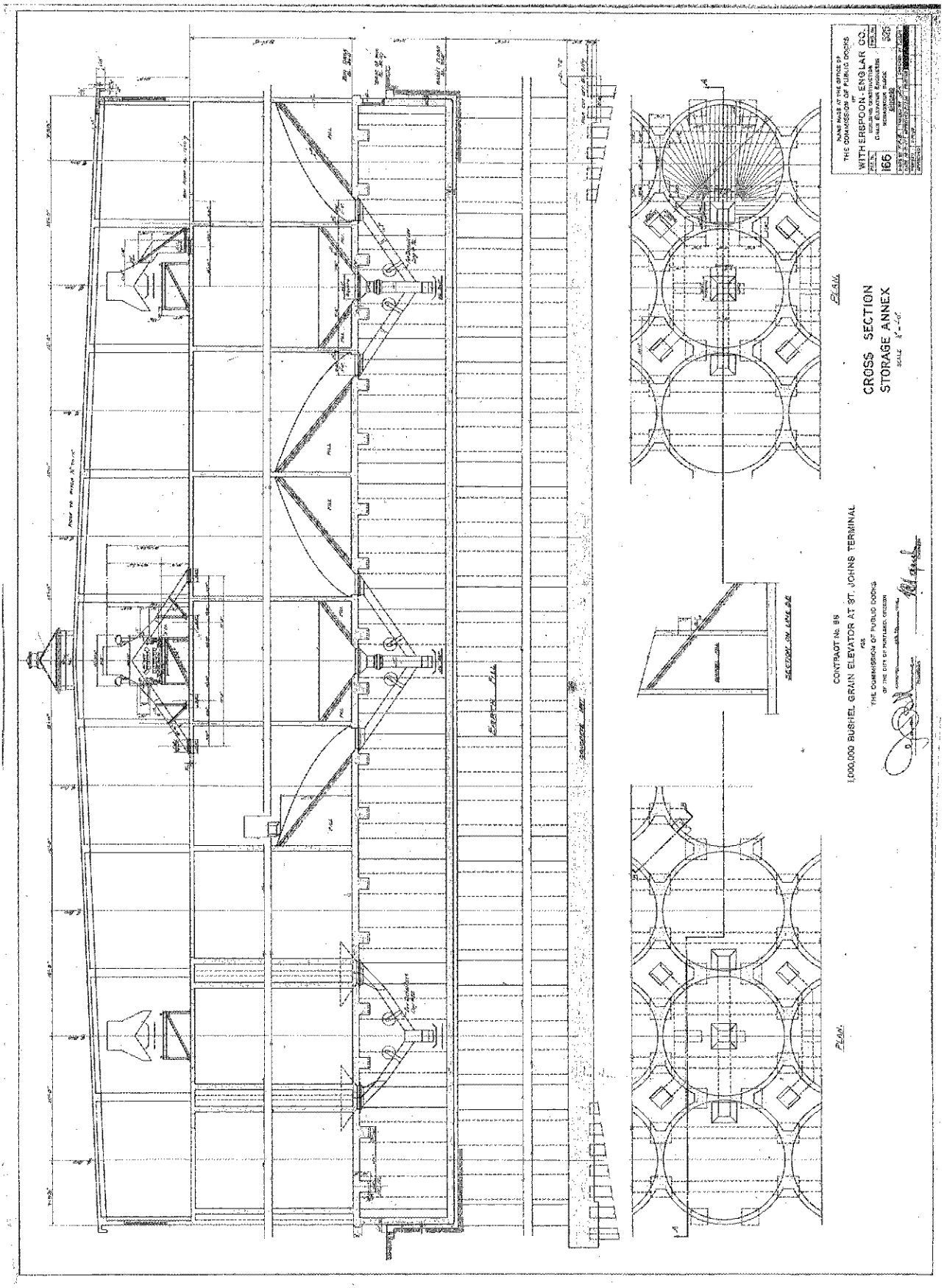
1,000,000 Bushel Grain Elevator at St. Johns Terminal, West Elevation, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0512



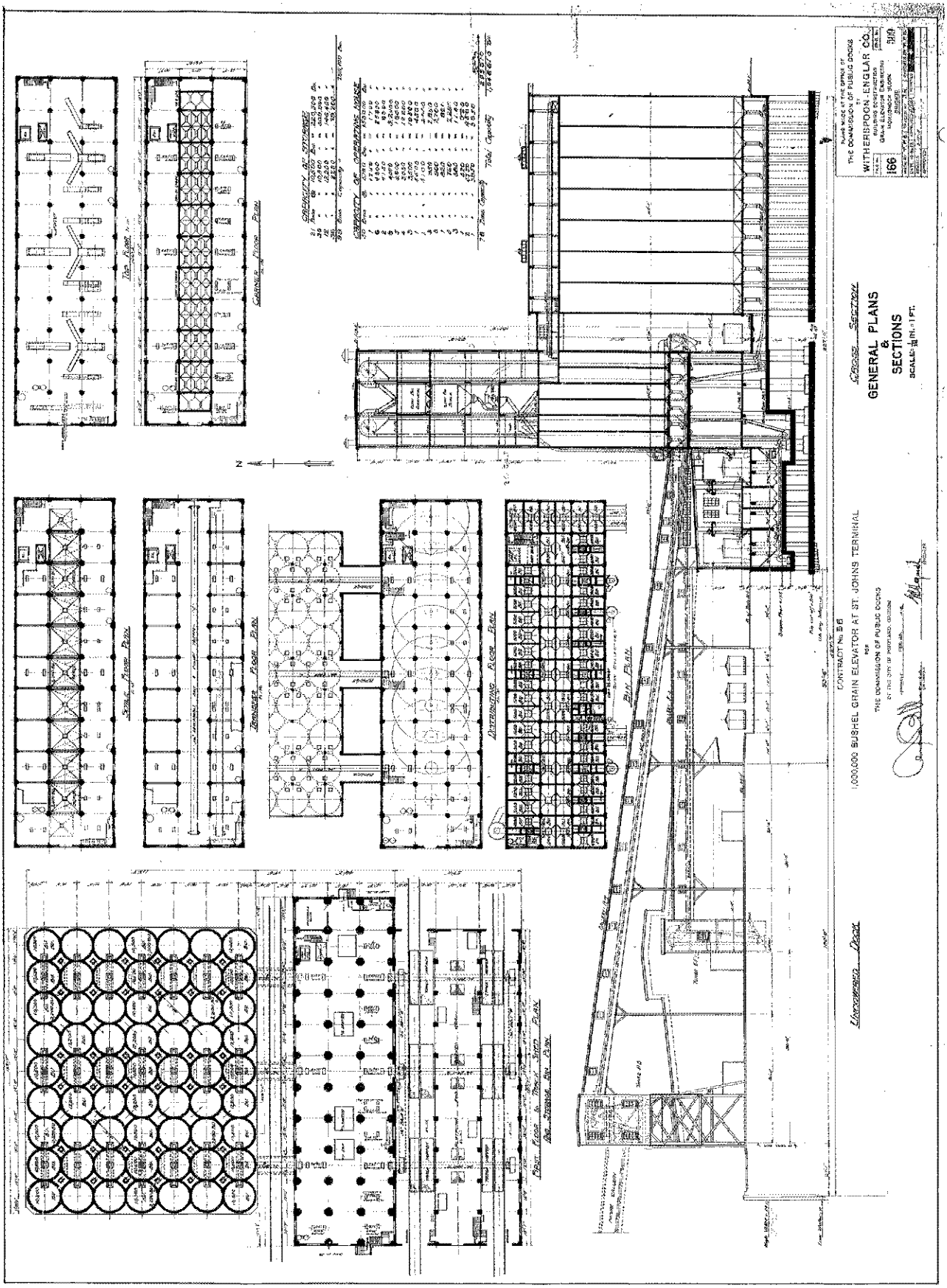
1,000,000 Bushel Grain Elevator at St. Johns Terminal, Lower Cross Section, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0514



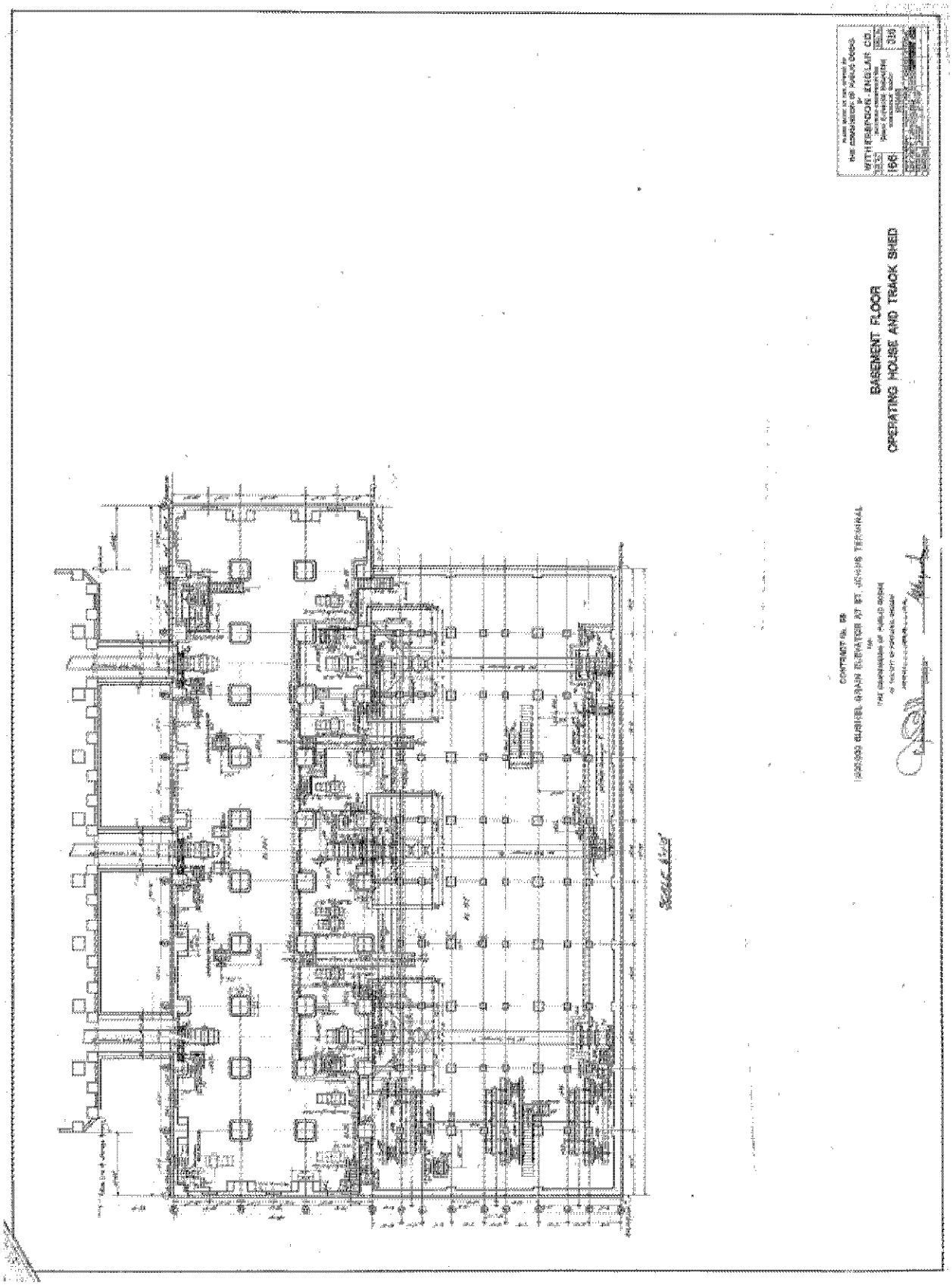
1,000,000 Bushel Grain Elevator at St. Johns Terminal, Upper Cross Sections Operating House, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0515



1,000,000 Bushel Grain Elevator at St. Johns Terminal, Cross Section Storage Annex, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0525



1,000,000 Bushel Grain Elevator at St. Johns Terminal, General Plans & Sections, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0509



1,000,000 Bushel Grain Elevator at St. Johns Terminal, Basement Floor Operating House and Track Shed, 1918.
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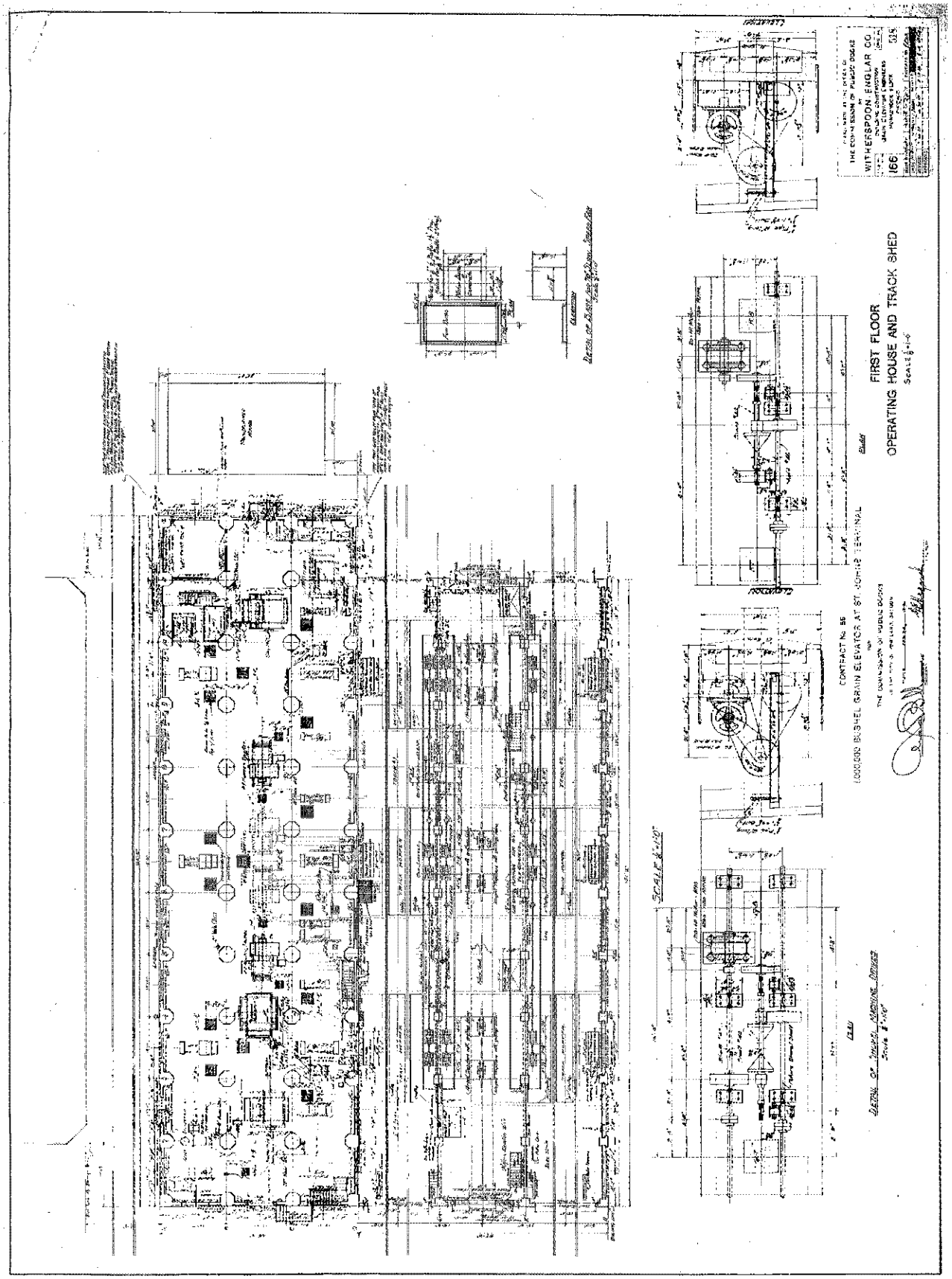

1,000,000 Bushel Grain Elevator at St. Johns Terminal, First Floor Operating House and Track Shed, 1918.
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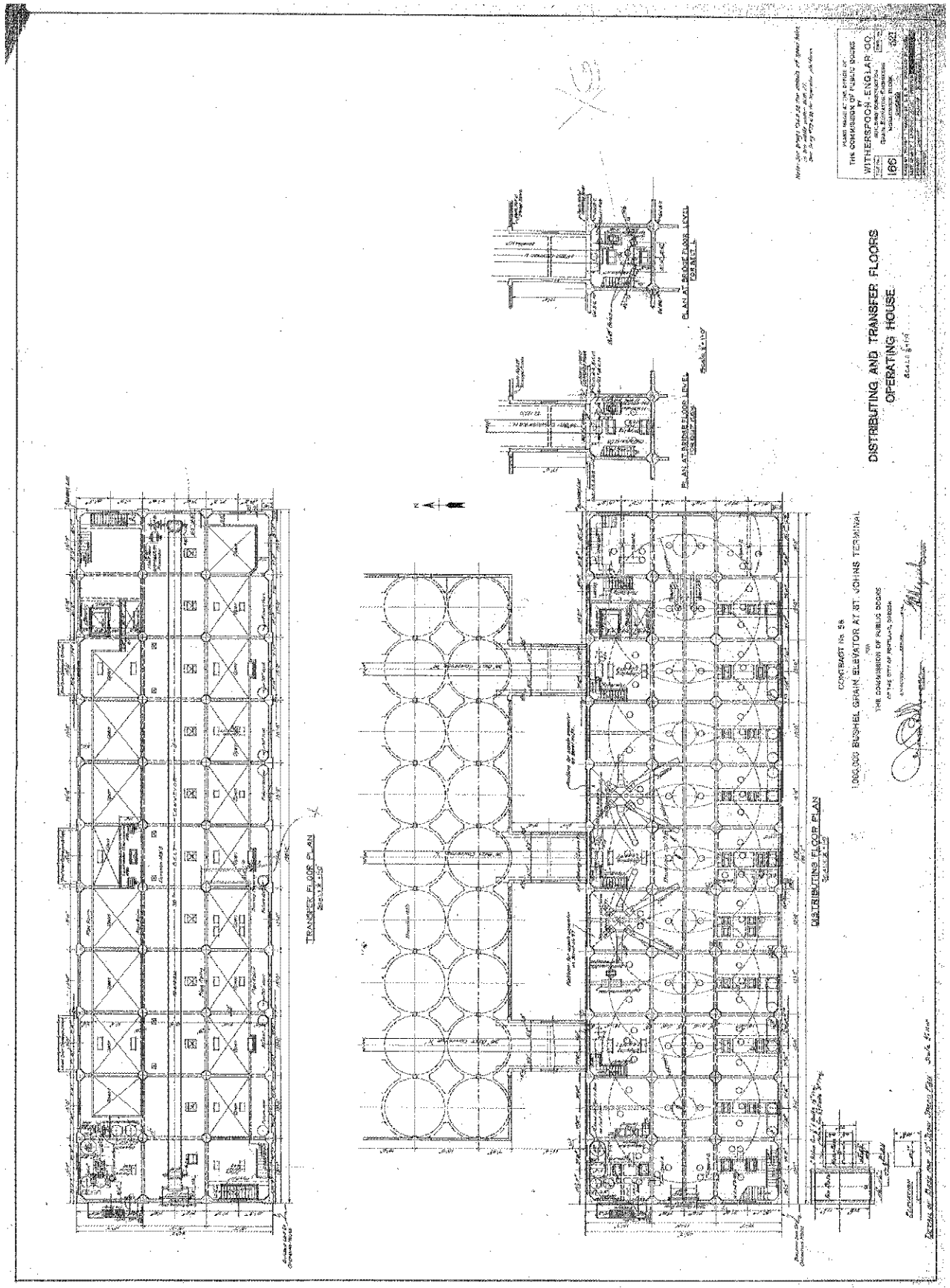

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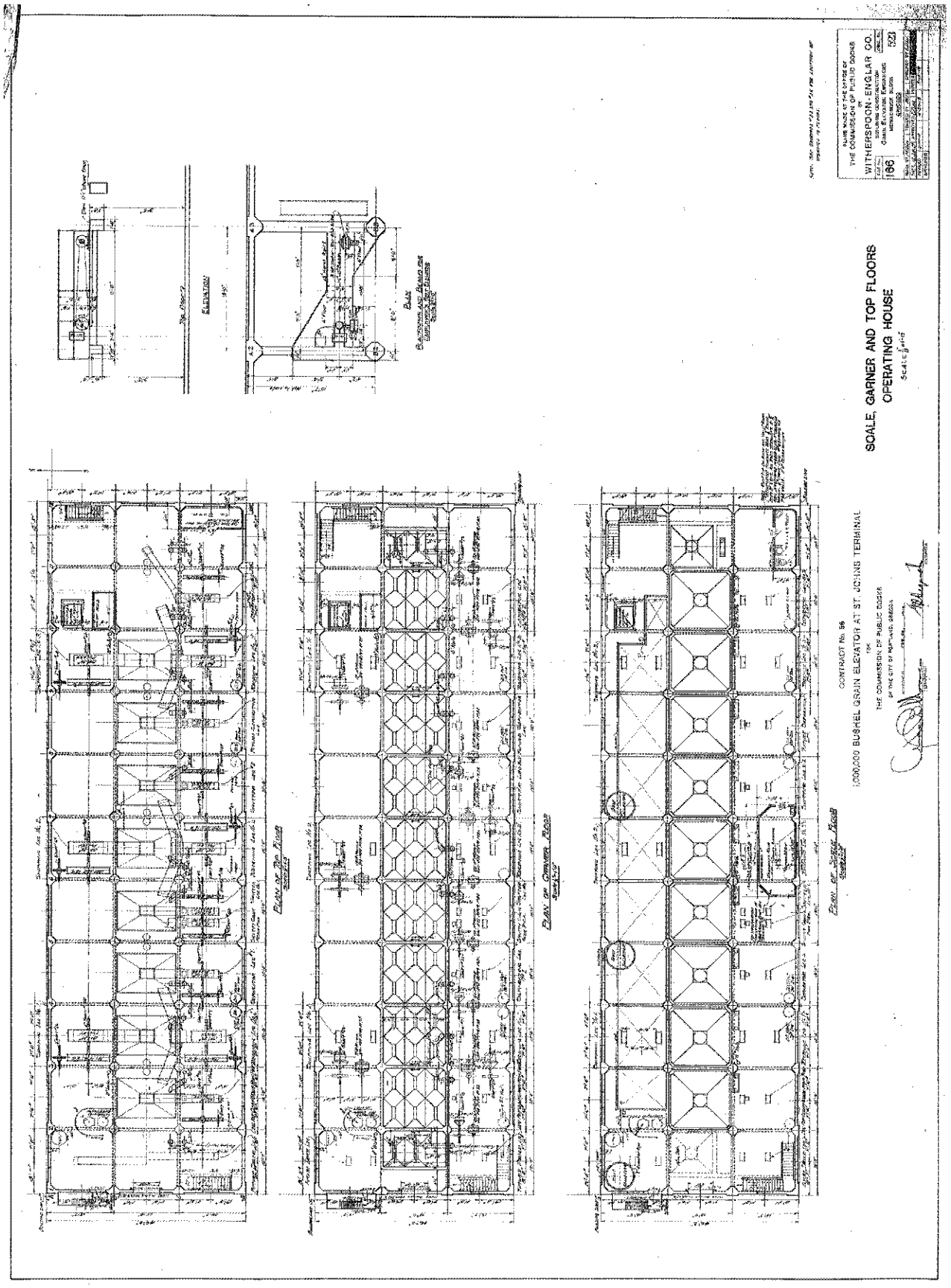

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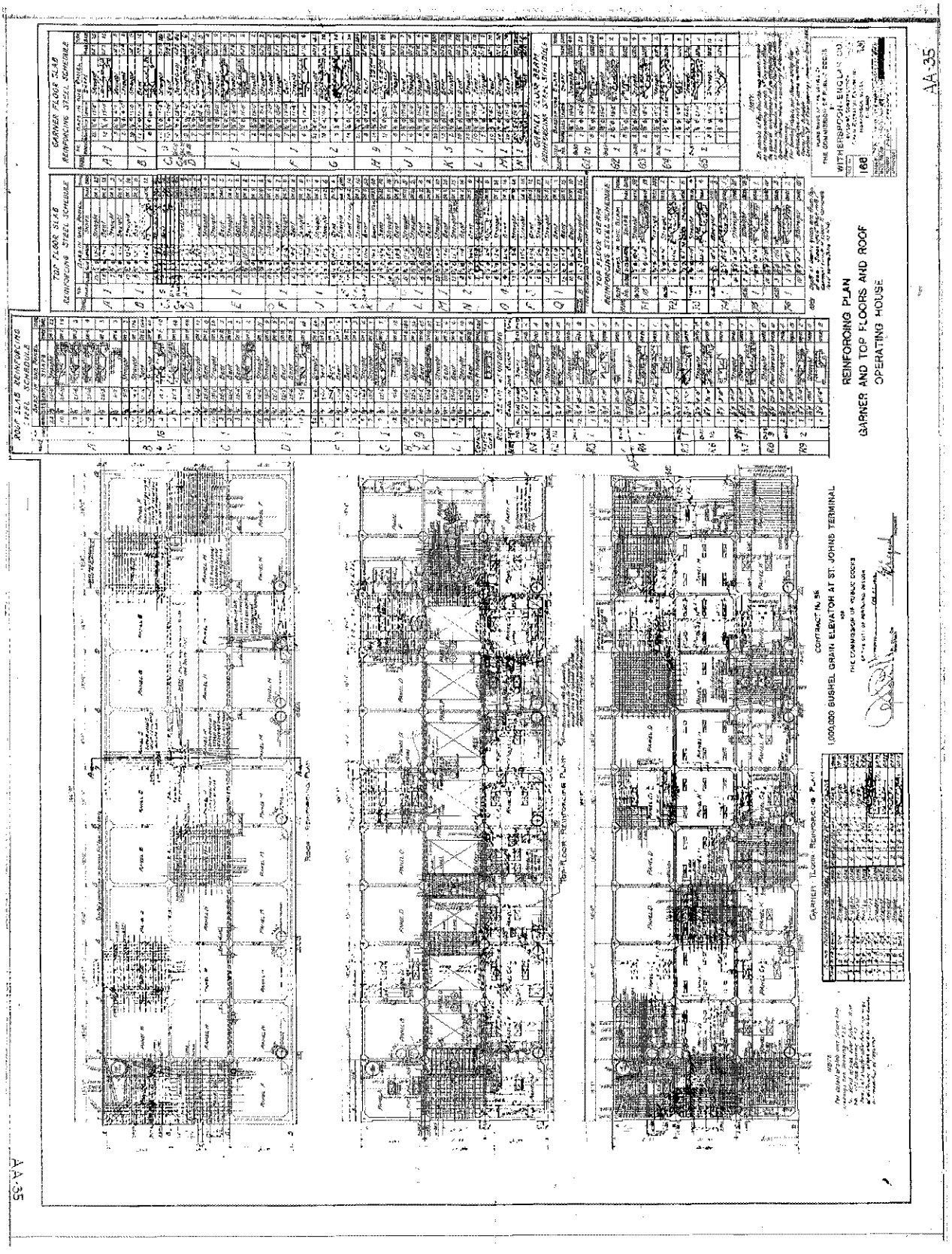

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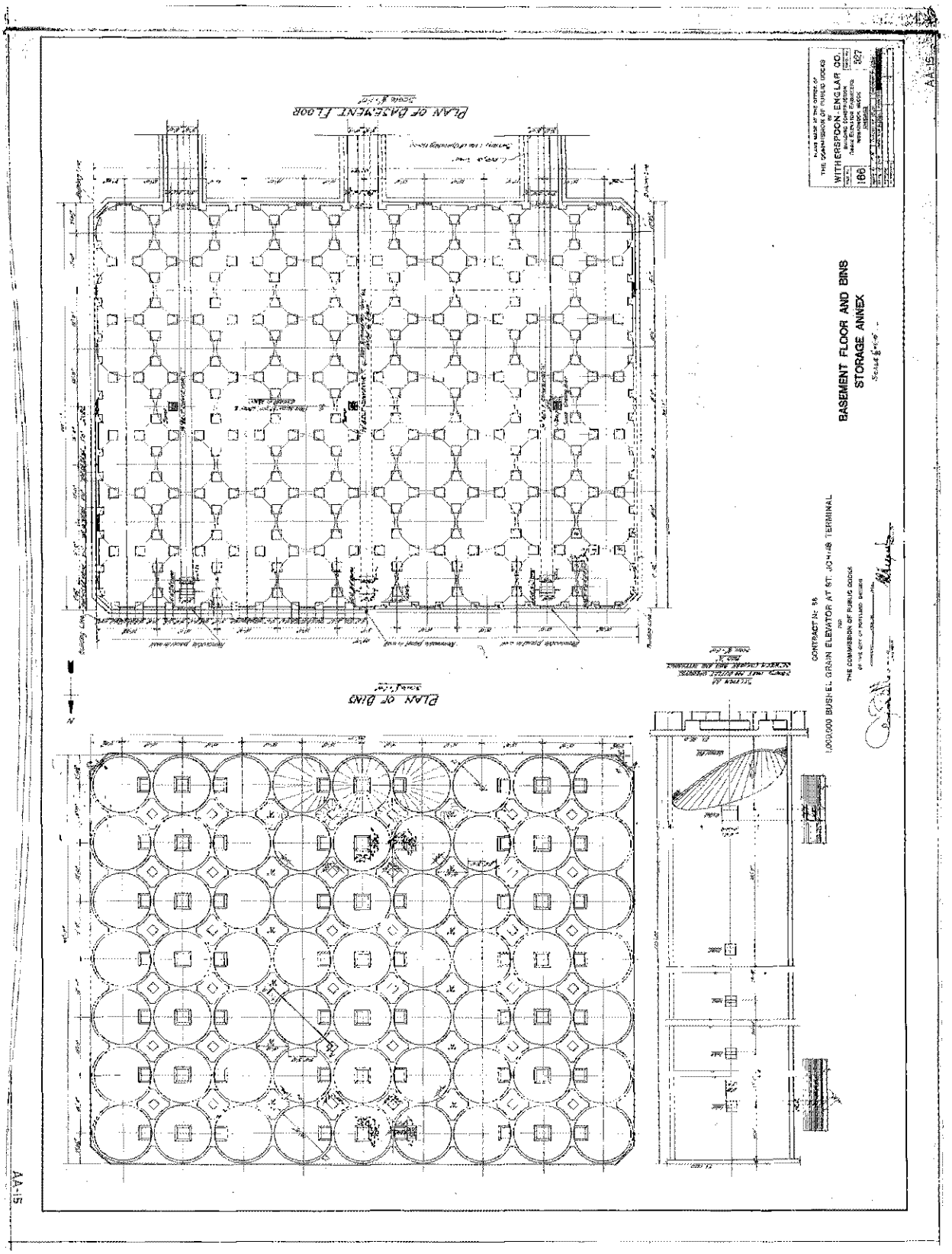

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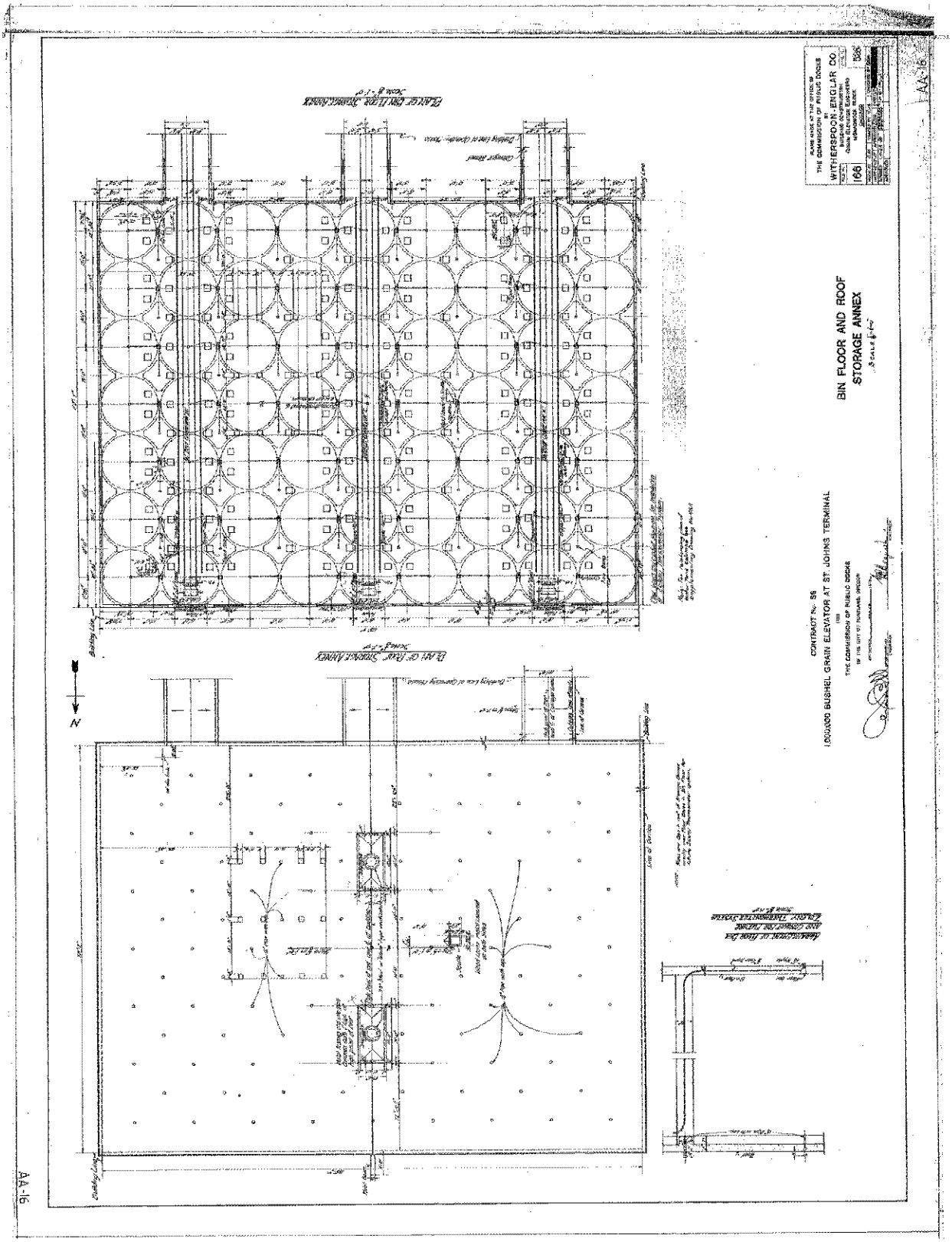

1,000,000 Bushel Grain Elevator at St. Johns Terminal, Bin Floor and Roof, Storage Annex, 1918.
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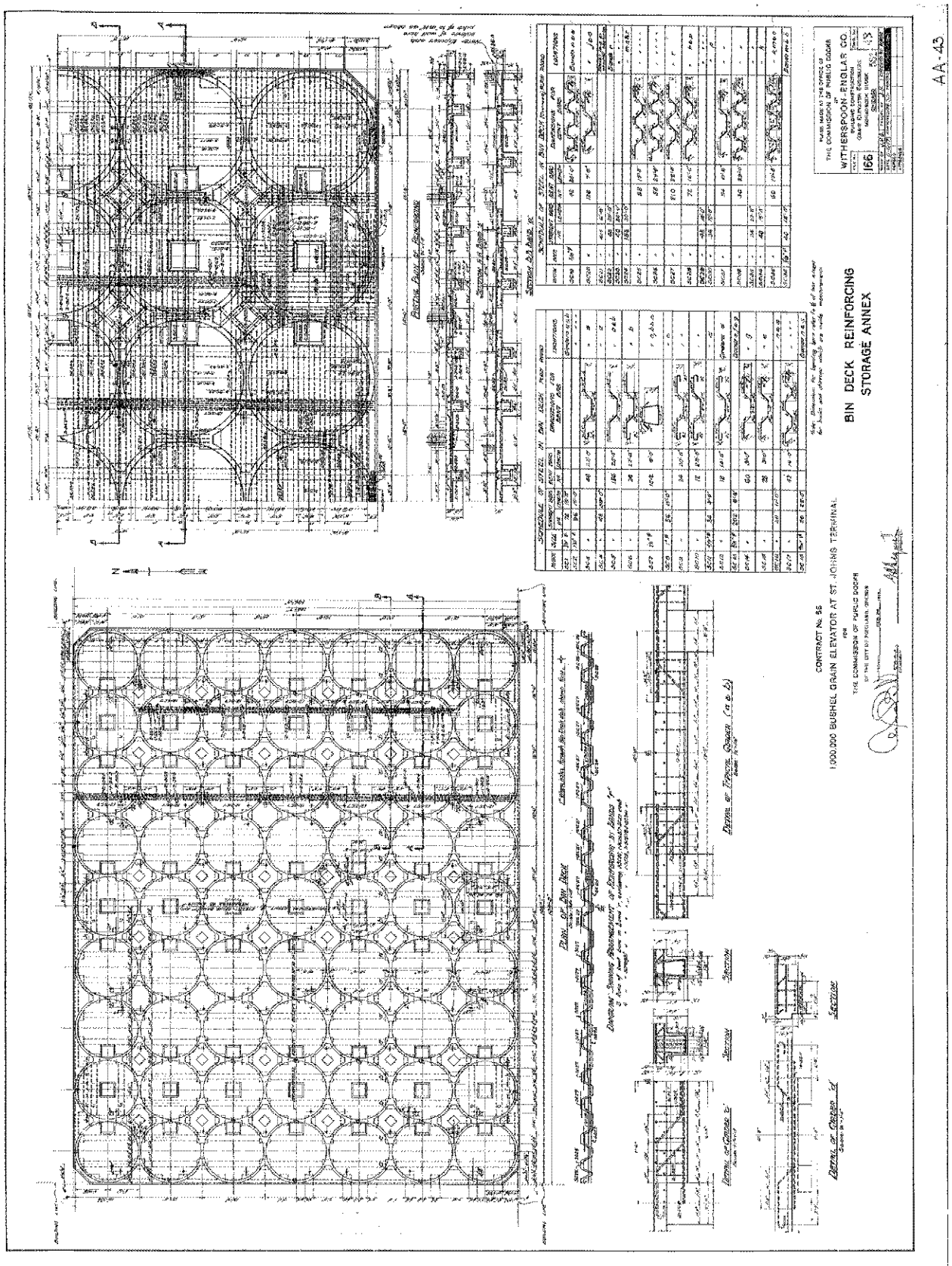
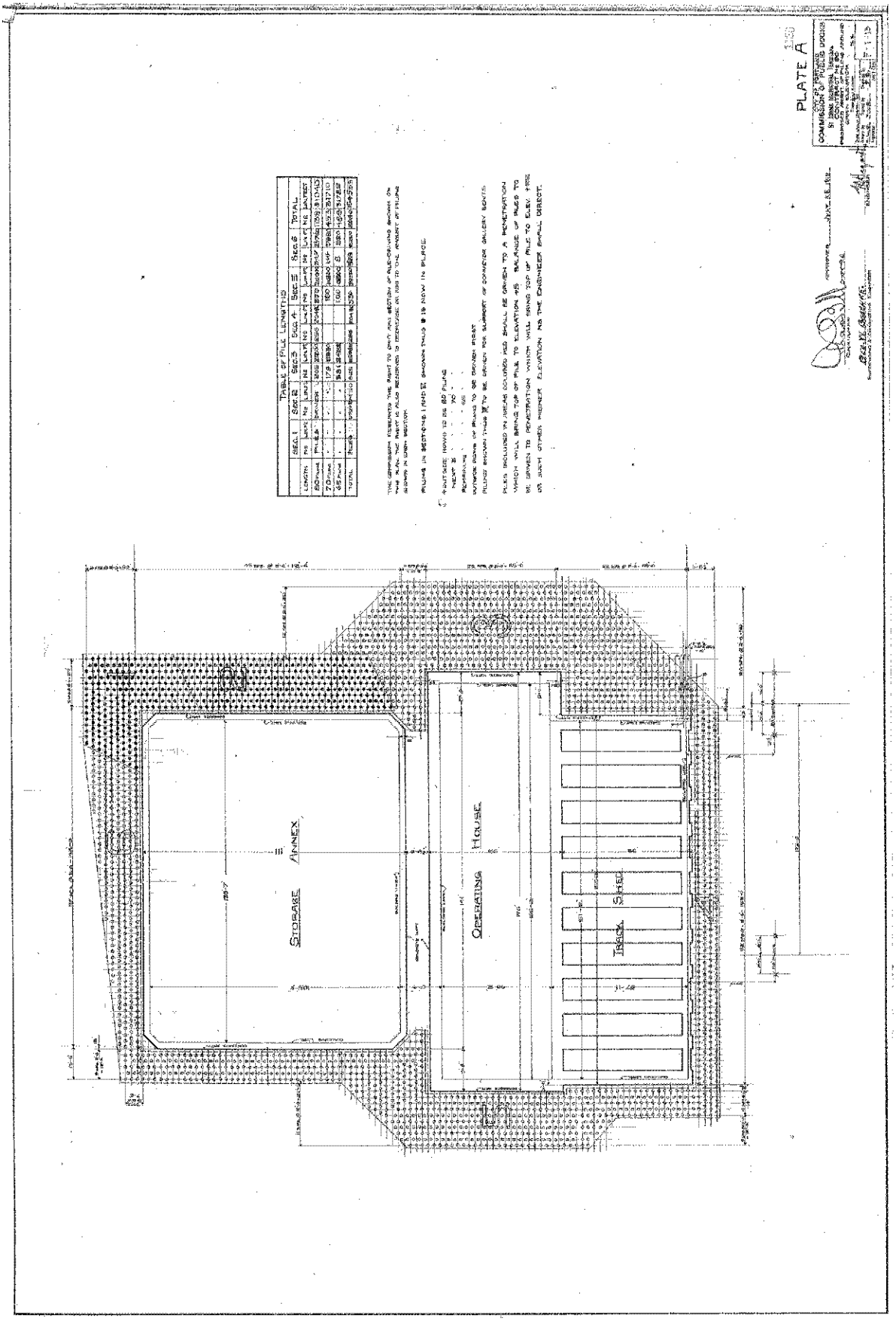
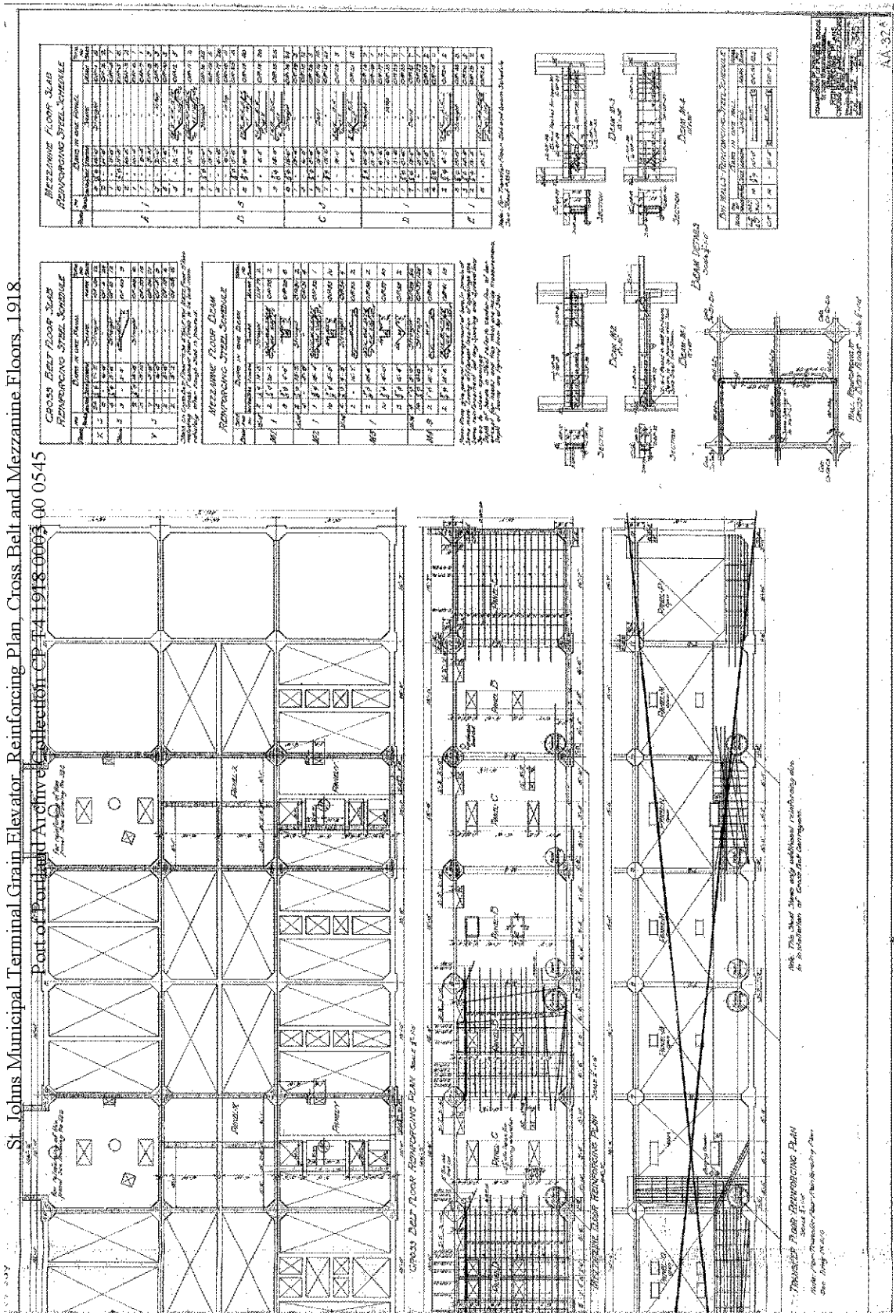


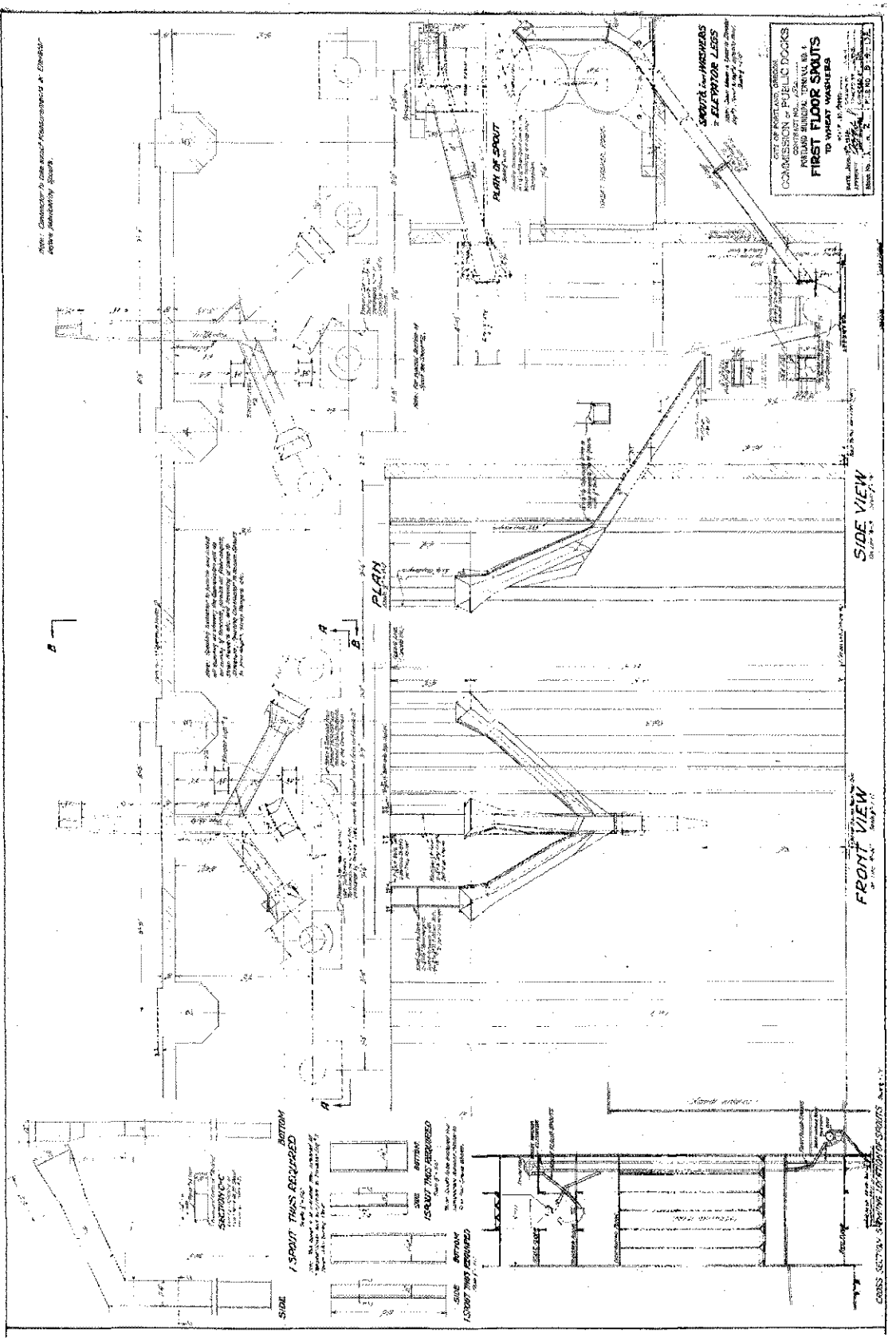
1,000,000 Bushel Grain Elevator at St. Johns Terminal, Bin Deck Reinforcing Roof, Storage Annex, 1918.
Port of Portland Archive Collection CP T4 1918 0003 00 0561



St. Johns Municipal Terminal, Proposed Arrangement of Piling Around Grain Elevator, 1919.
Port of Portland Archive Collection CP T4 1919 0014 00 1130

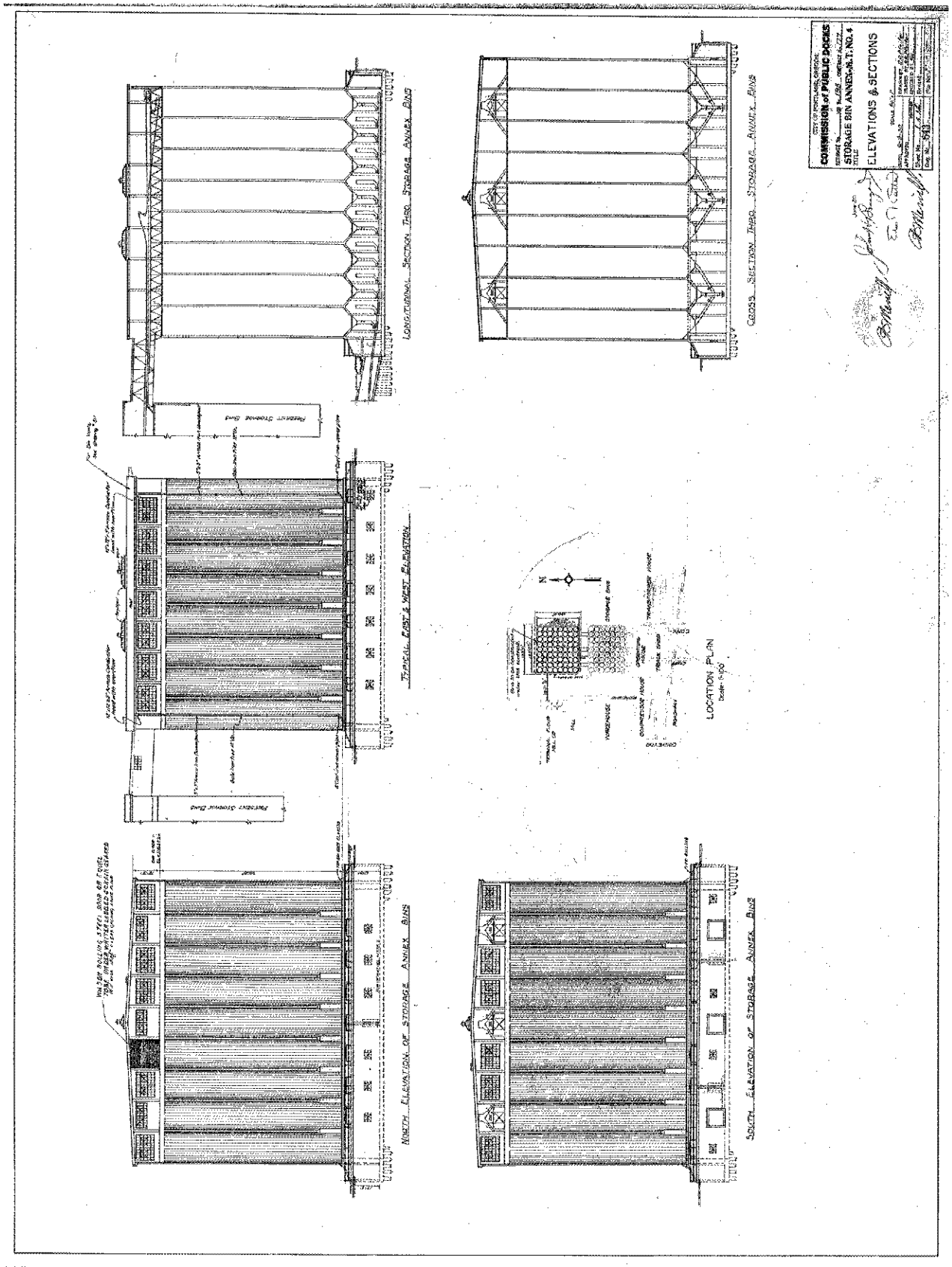


St. Johns Municipal Terminal Grain Elevator, Reinforcing Plan, Cross Belt & Mezz. Floors, 1919.
The Commission of Public Docks CP T4 1918 0003 00 0545

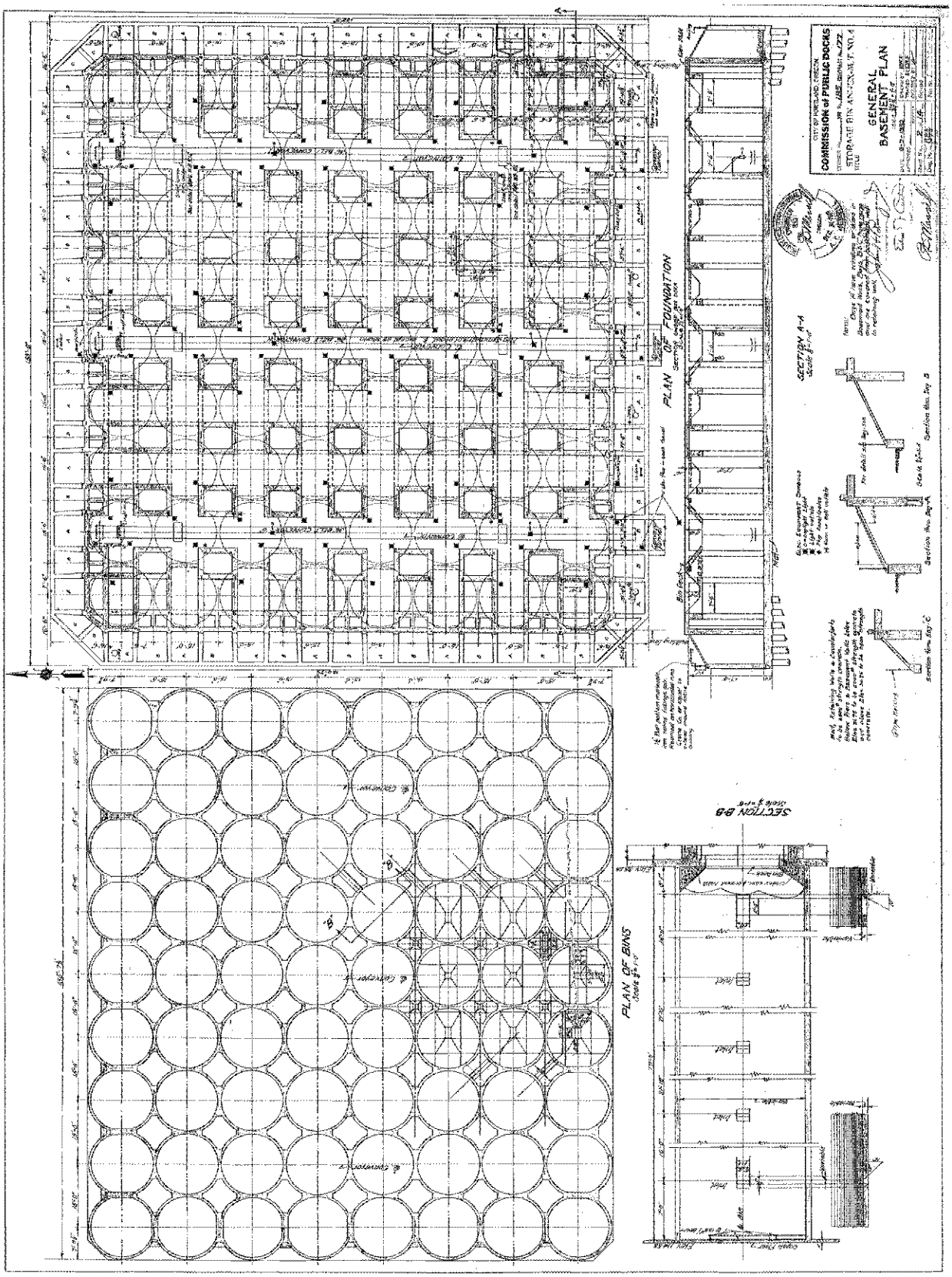


First Floor Spouts to Wheat Washers, Operating House, 1924.
Port of Portland Archive Collection CP T4 1924 0008 00 1139

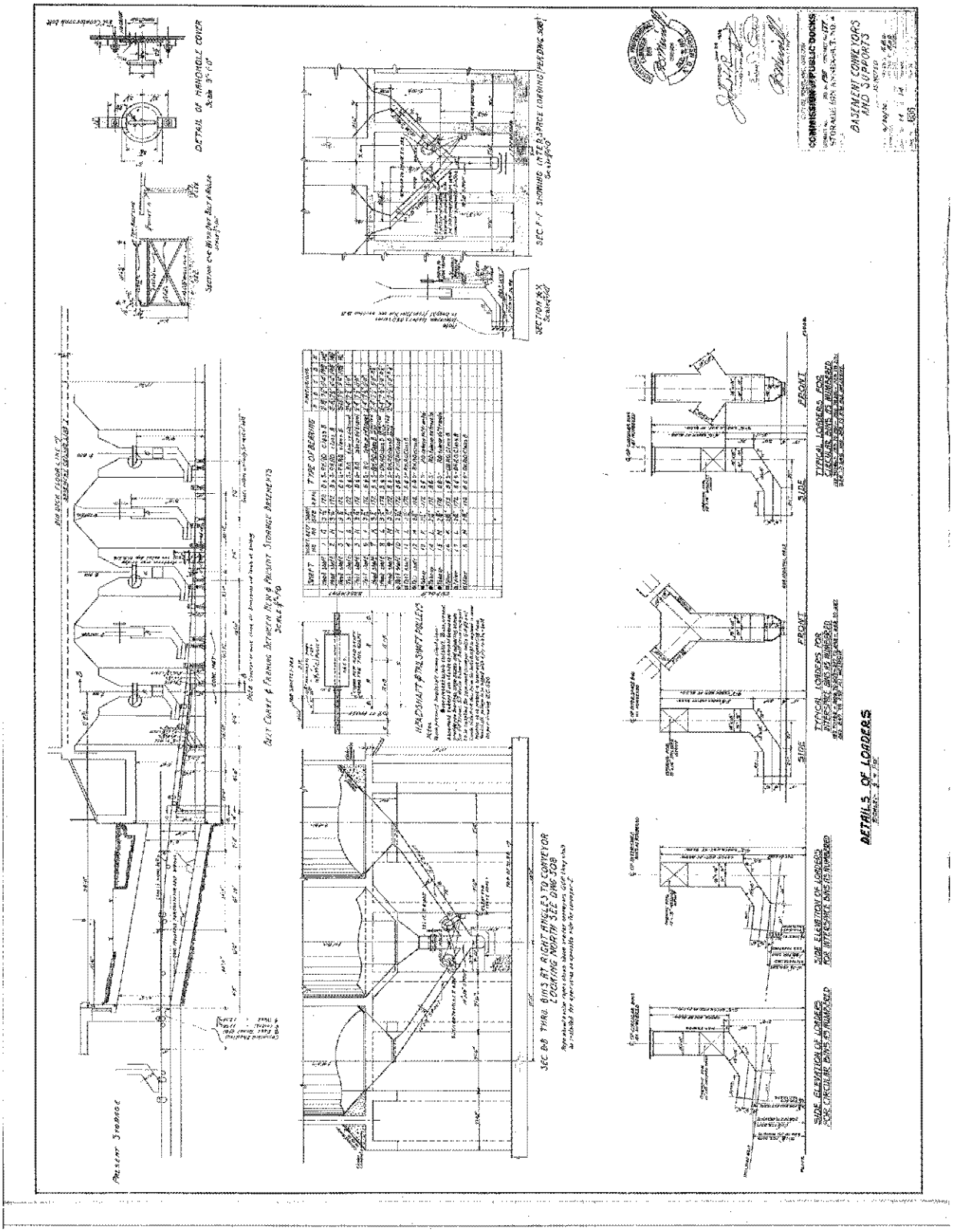
First Floor Spouts to Wheat Washers, 1924.
The Commission of Public Docks CP T4 1924 0008 00 1139



1,000,000 Bushel Storage Bin Annex No. 2, addition to Terminal No. 4 Grain Elevator, Elevations & Sections, 1930.
Port of Portland Archive Collection CP T4 1930 0002 00 0643



Storage Bin Annex No. 2, General Basement Plan, 1930.
Port of Portland Archive Collection CP T4 1930 002 00 0644



Storage Bin Annex No. 2, Basement Conveyors and Supports, 1930.
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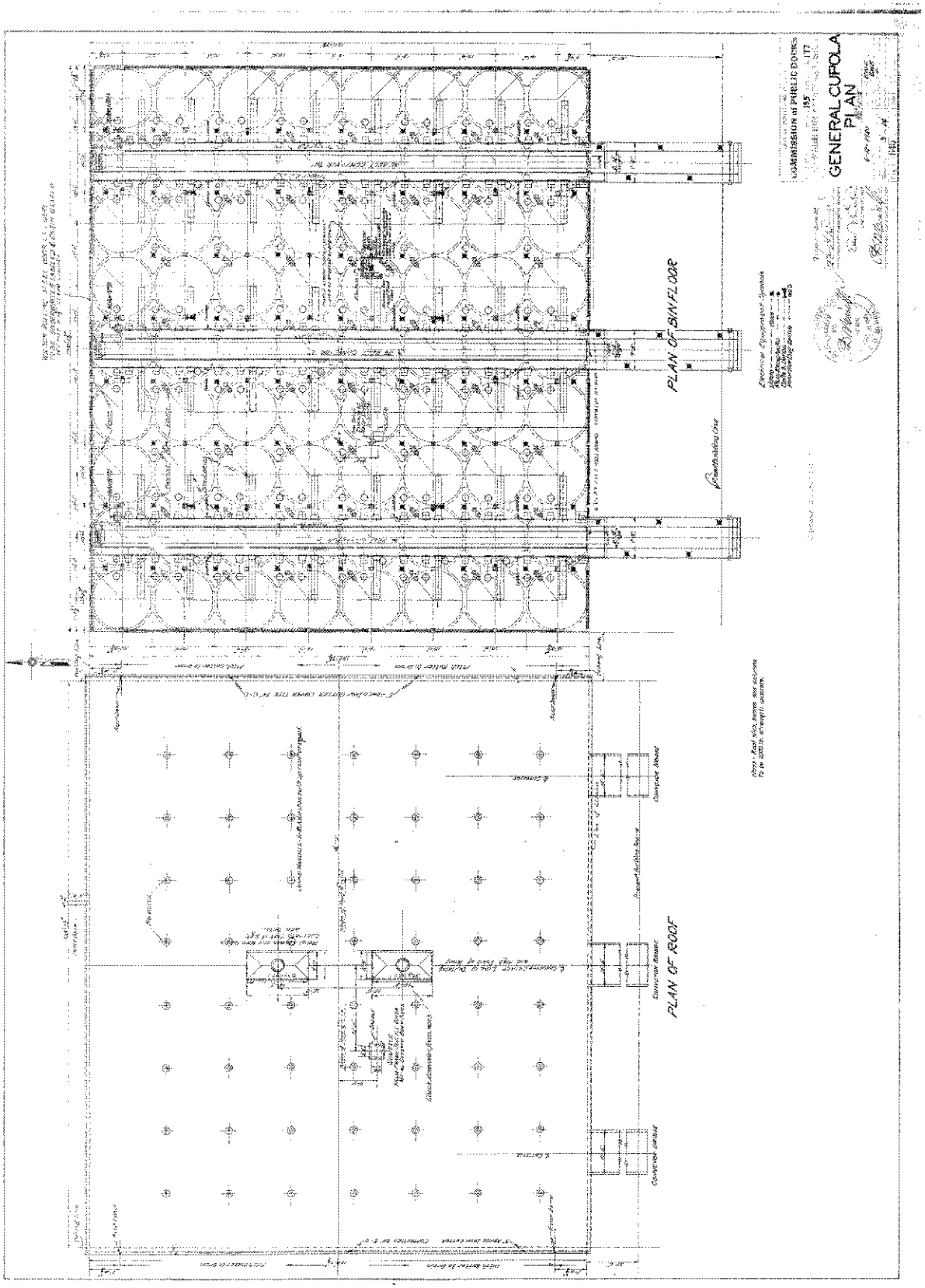
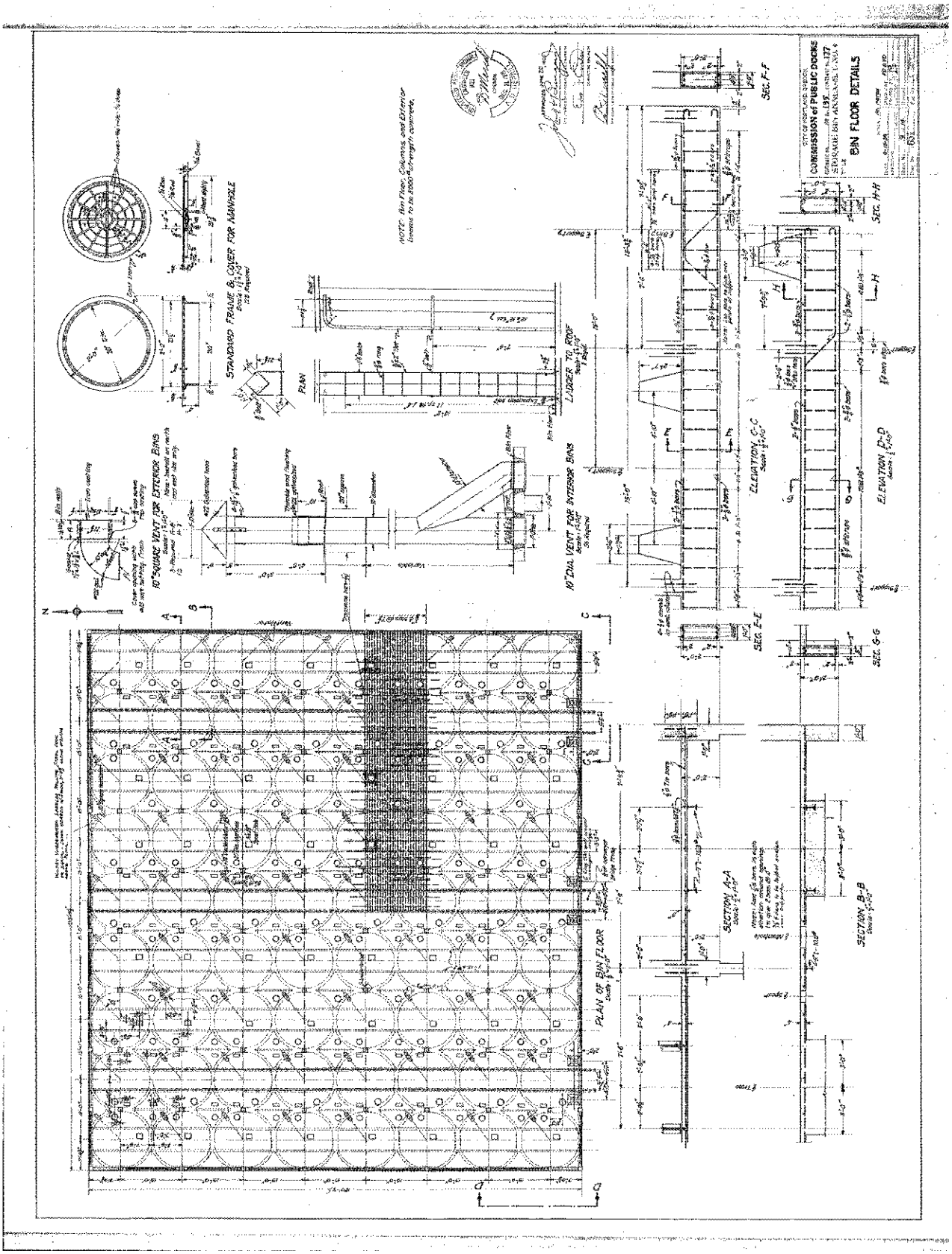
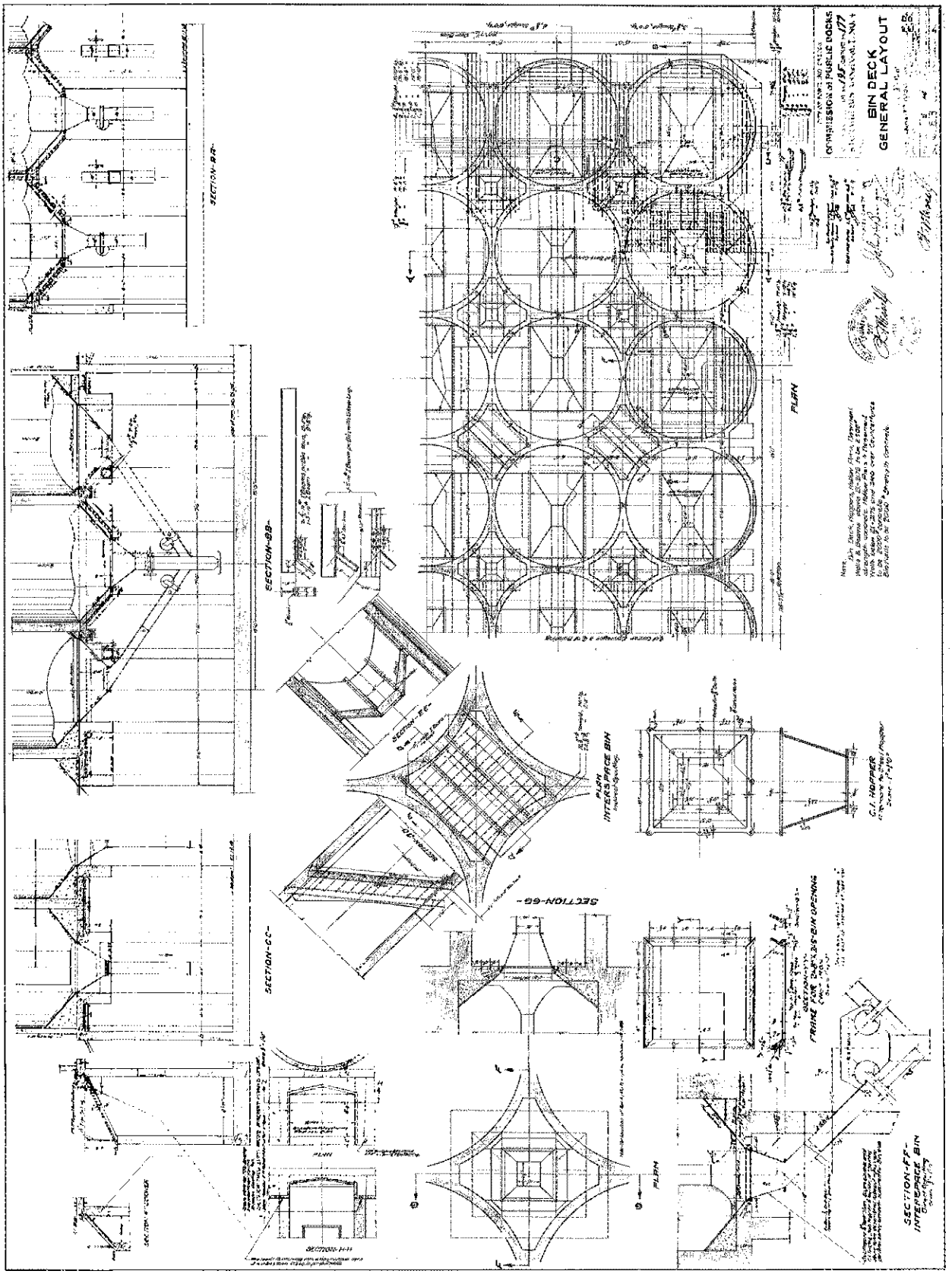


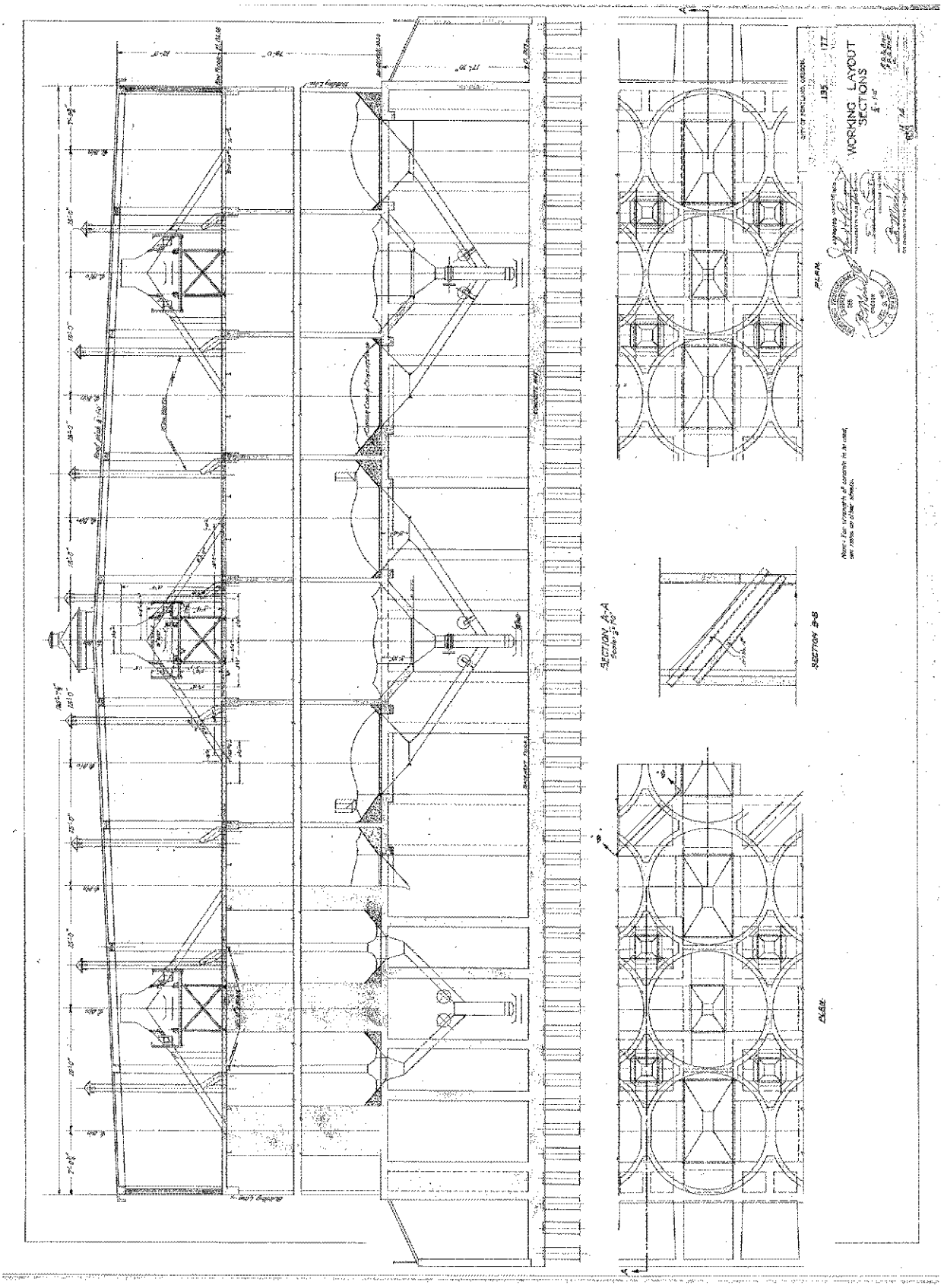
Storage Bin Annex No. 2, General Cupola Plan, 1930.
Port of Portland Archive Collection CP T4 1930 0002 00 0645



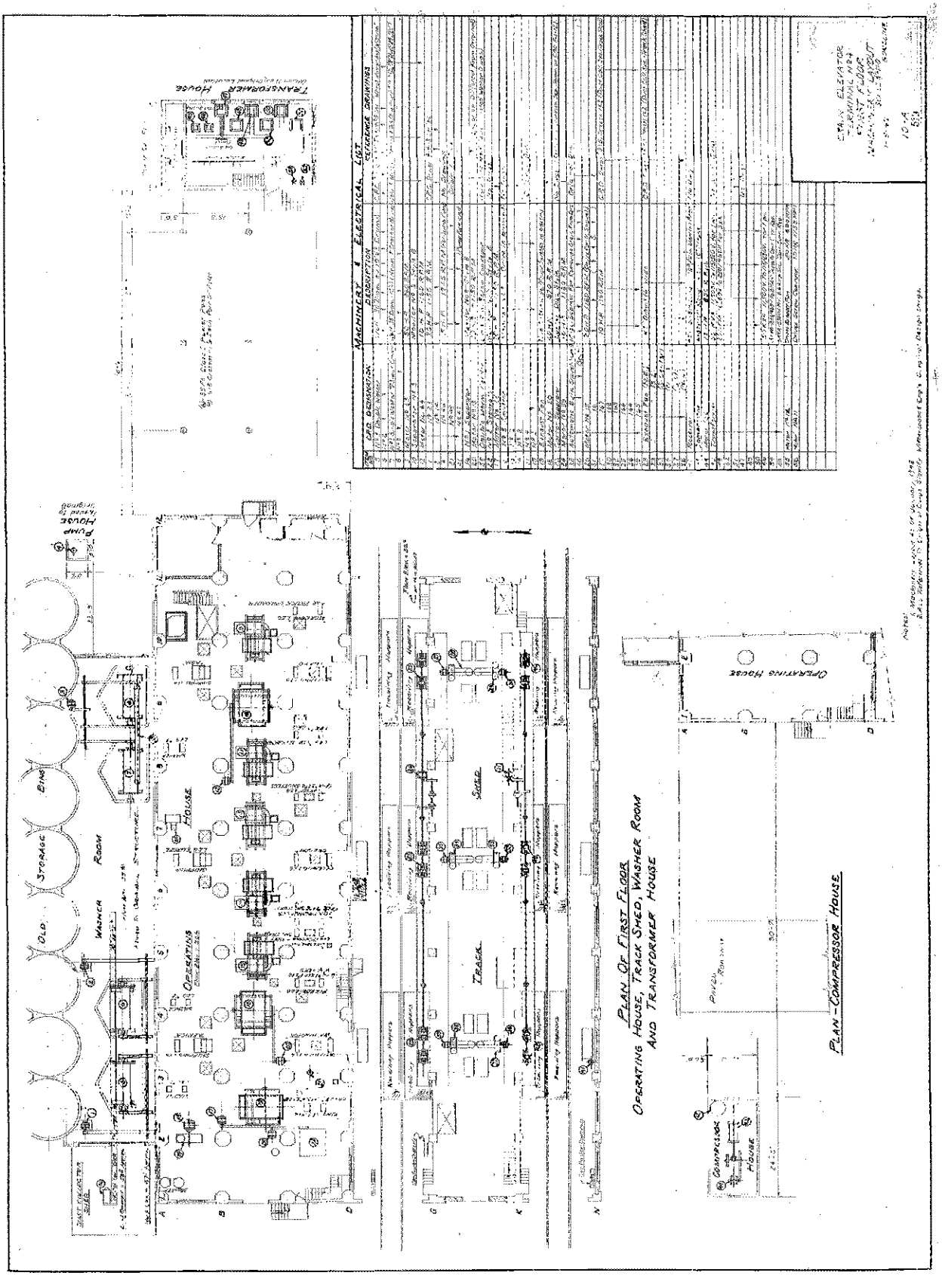
Storage Bin Annex No. 2, Bin Floor Details, 1930.
Port of Portland Archive Collection CP T4 1930 0002 00 0651



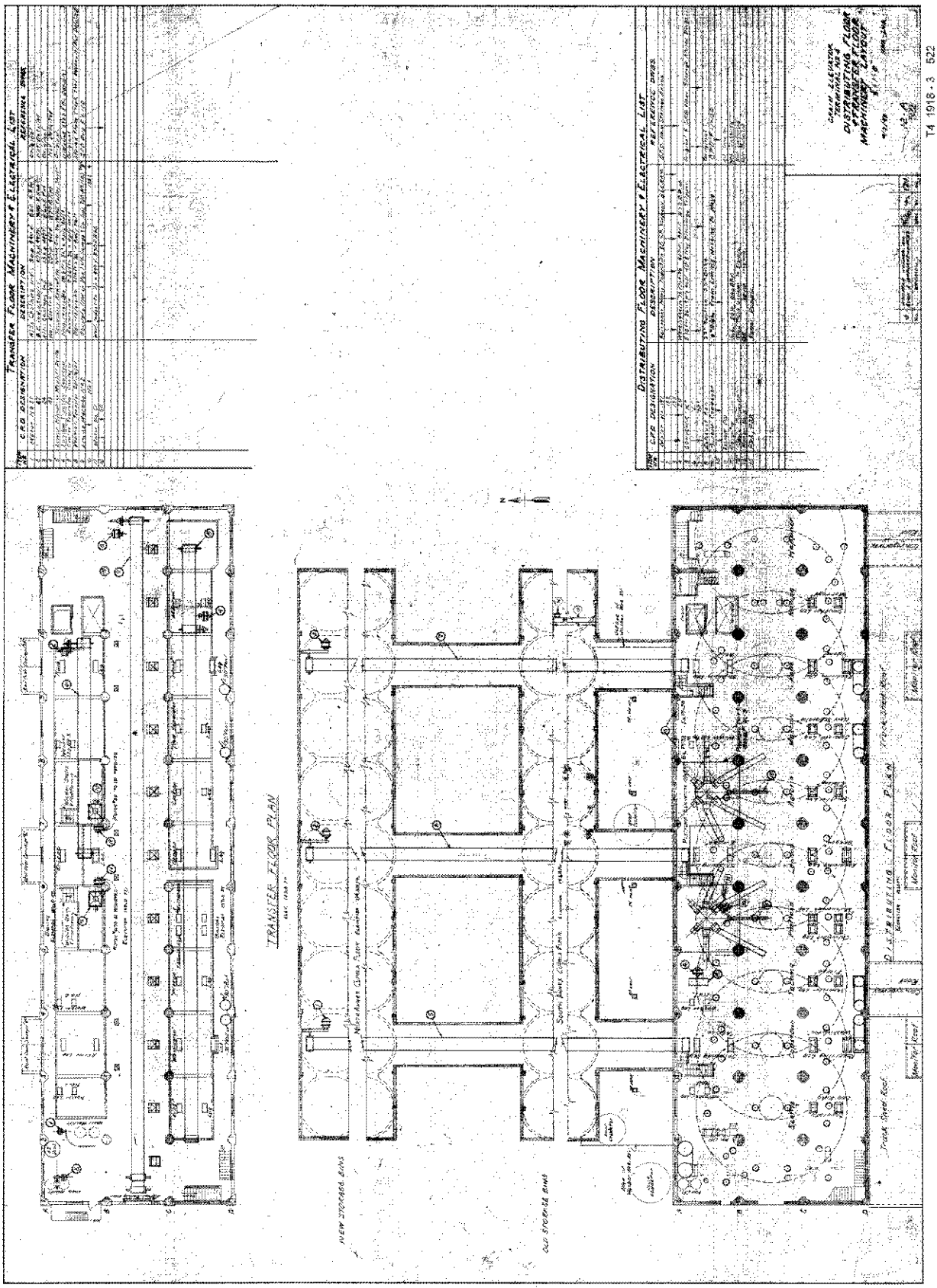
Storage Bin Annex No. 2, Bin Deck General Layout, 1930.
Port of Portland Archive Collection CP T4 1930 0002 00 0648



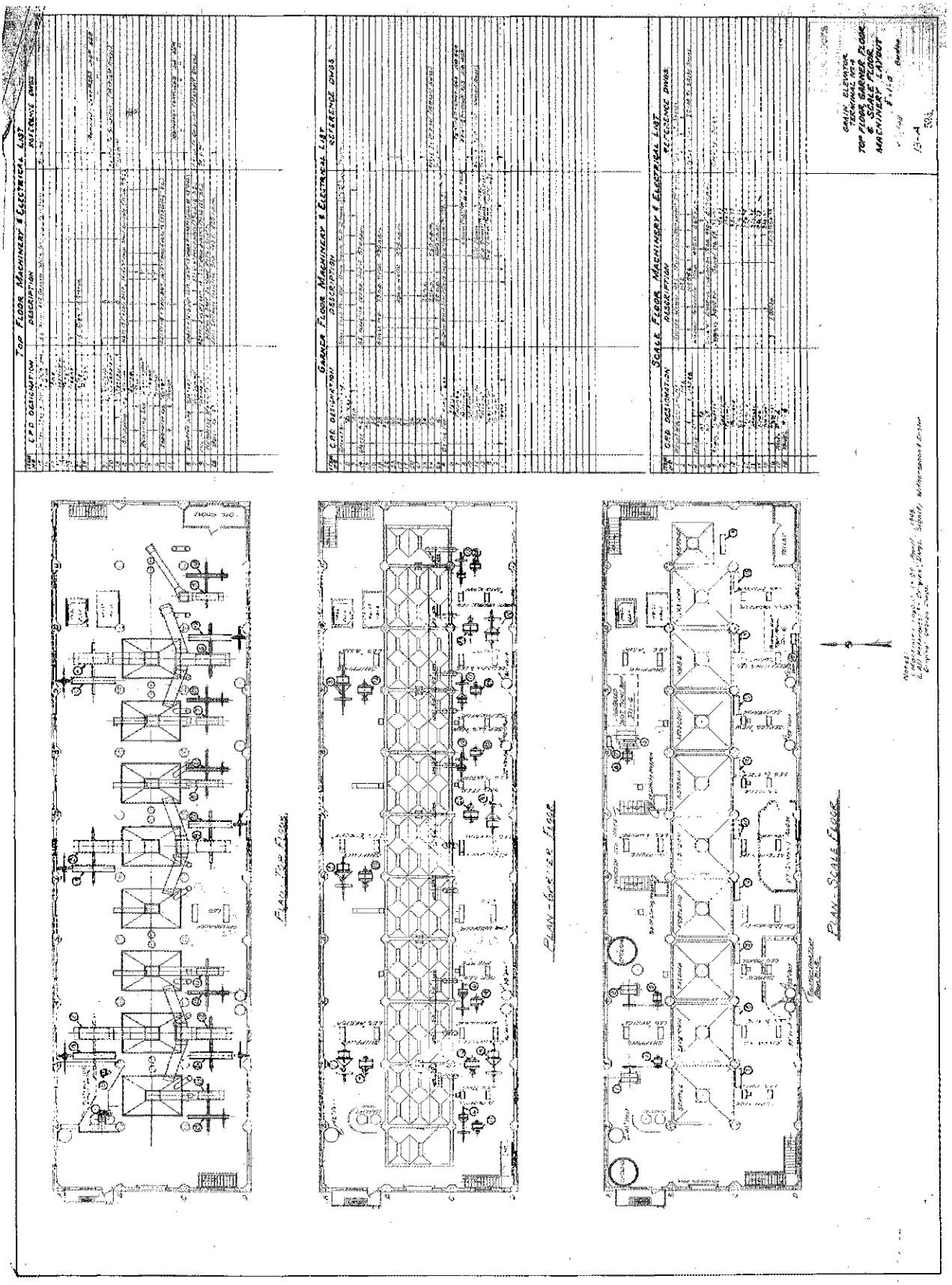
Storage Bin Annex No. 2, Working Layout Sections, 1930.
Port of Portland Archive Collection CP T4 1930 0002 00 0653



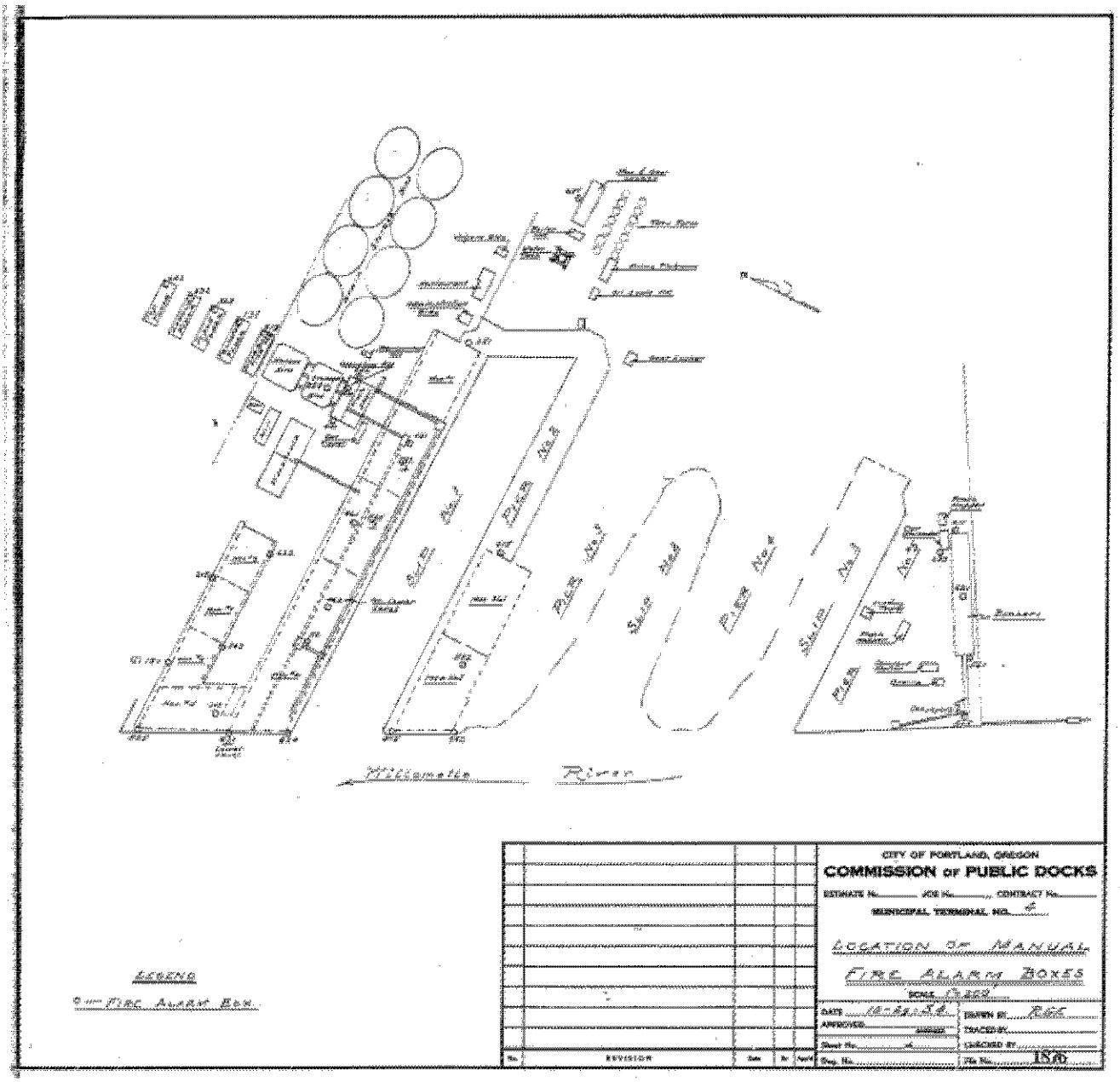
Grain Elevator Terminal No. 4, Distributing Floor & Transfer Floor Machinery Layout, 1947.
Port of Portland Archive Collection CP T4 1918 0003 00 0519



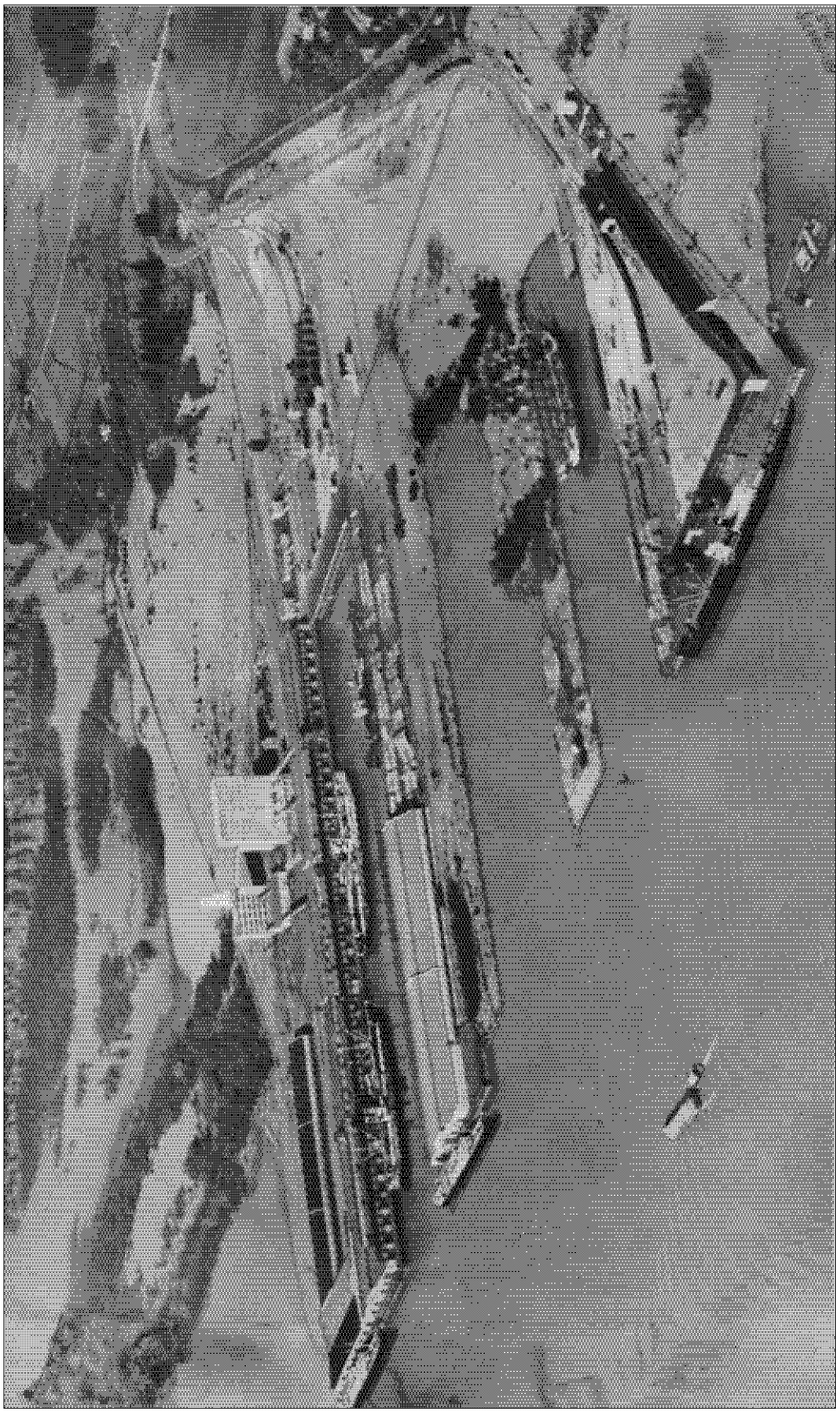
Grain Elevator Terminal No. 4, Distributing Floor & Transfer Floor Machinery Layout, 1948.
Port of Portland Archive Collection CP T4 1918 0003 00 0522



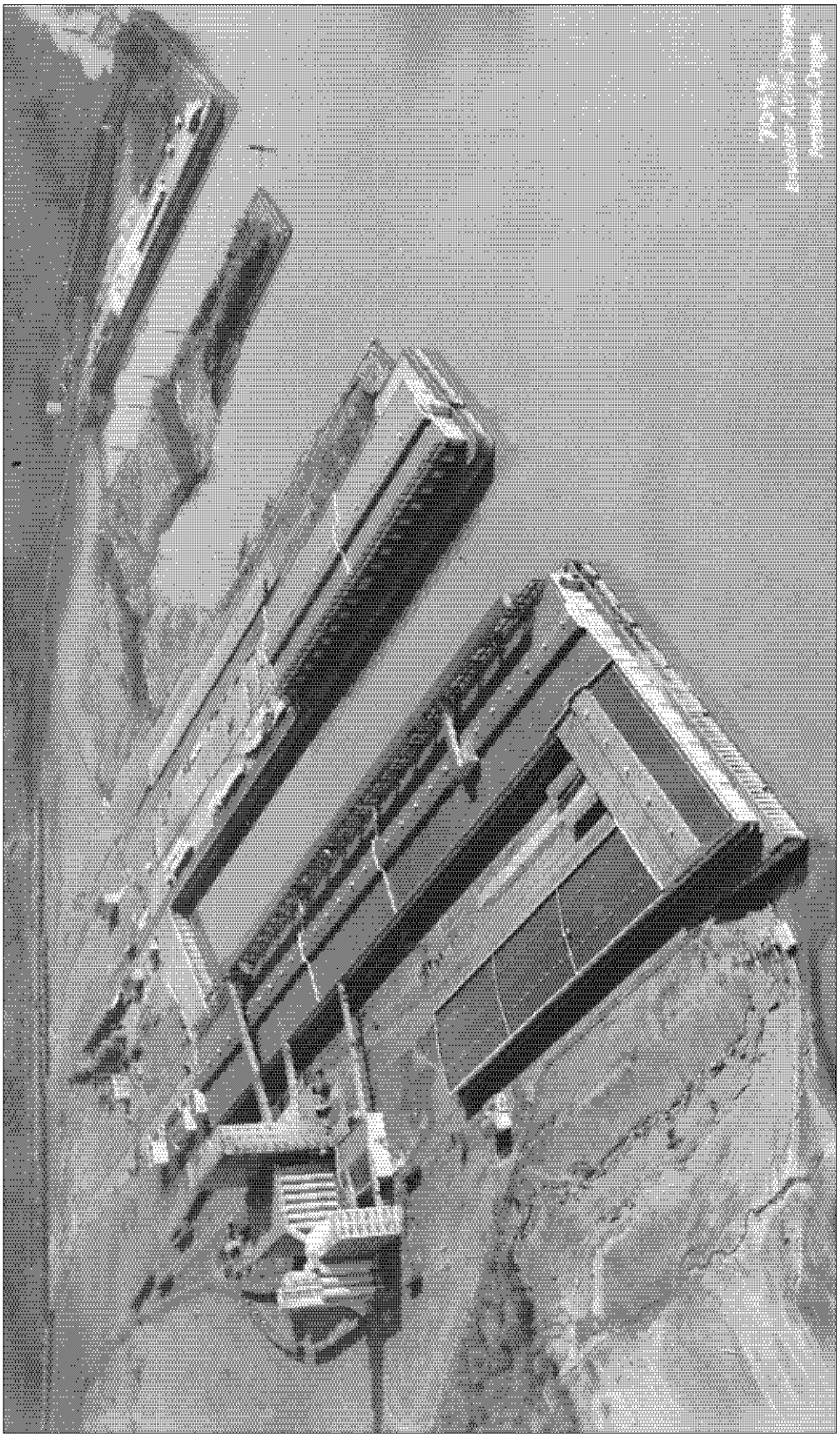
Grain Elevator Terminal No. 4, Distributing Floor & Transfer Floor Machinery Layout, 1948.
Port of Portland Archive Collection CP T4 1918 0003 00 0524



Site plan of Terminal No. 4 showing Location of Manual Fire Alarm Boxes, 1954.
Port of Portland Archive Collection CP T4 1917 0002 00 1035

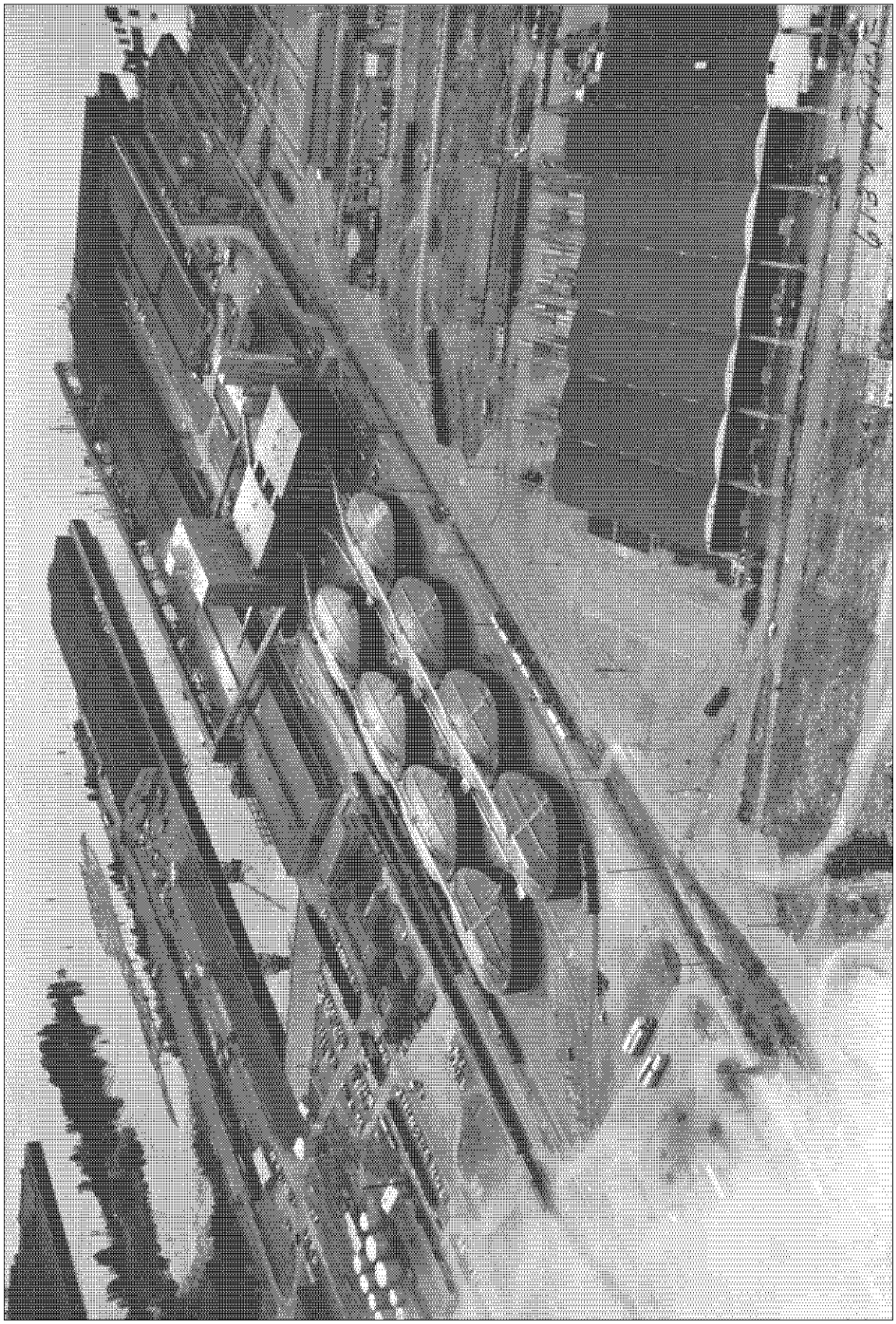


Looking northeast at Terminal No. 4, grain elevator, and terminal flour mill. 1925.
Port of Portland Archive Photograph Collection PH T4 1925 4003 00 0001 0



Looking southeast at Terminal No. 4, 1920s.
Port of Portland Archive Photograph Collection PH T4 1929 4003 00 0005 0

Looking north at Terminal No. 4, Storage Bin Annex No. 2 is built, 1930s.
Port of Portland Archive Photograph Collection PH T4 1930 4003 00 0001 0



Looking southwest and showing the 1955 steel storage tanks addition, 1956.
Port of Portland Archive Photograph Collection PH T4 1956 4002 00 0006 0

Looking northeast, showing 1955 steel storage bin addition and former location of Kaiser shipyard (lower left-hand corner), 1957.
Port of Portland Archive Photograph Collection PH T4 1957 4007 00 0010 0

Looking northwest. Most of Pier 1 and Pier 2 were removed at this time, 2000.
Port of Portland Archive Photograph Collection PH T4 2000 0001 00 0003 0